APPENDIX B: ECONOMICS

NAVIGATION STUDY FOR JACKSONVILLE HARBOR, FLORIDA

DRAFT INTEGRATED GENERAL REEVALUATION REPORT II

AND

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

RESULTS OF THE FINAL SCREENING

- **44'**
  - AAEQ Benefits ....$40.0M – $49.0M
  - Net AAEQ Benefits ....$14.9M – $23.9M
  - BCR ....1.60 – 1.95

- **45'**
  - AAEQ Benefits ....$46.2M – $54.3M
  - Net AAEQ Benefits ....$18.8M – $26.9M
  - BCR ....1.68 – 1.98

- **46'**
  - AAEQ Benefits ....$46.9M – $54.0M
  - Net AAEQ Benefits ....$11.9M – $19.0M
  - BCR ....1.34 – 1.54

- **47'**
  - AAEQ Benefits ....$48.2M – $55.8M
  - Net AAEQ Benefits ....$11.1M – $18.7M
  - BCR ....1.30 – 1.51

NED PLAN = 45'

LPP PLAN = 47'

1 INTRODUCTION TO THE JACKSONVILLE HARBOR GRR-II DEEPENING AND WIDENING STUDY

The goals of this section it to explain the study circumstances, anticipated problems and objectives, as well as convey an understanding of the purpose and focus of the economic analysis. Information on the data sources used to describe the study and project area and the layout of the appendix will also be provided.

1.1 THE JACKSONVILLE HARBOR FEDERAL NAVIGATION PROJECT: THE CONTEXT

This section will provide the provide an overview of the project in terms of what it is, where it is, how it came to be, and why it is being studied. The goal is to convey an understanding of the circumstances surrounding the situation leading to the study.

- ***What is the Jacksonville Harbor Federal Navigation Project?***

The federal project is a navigation channel that accommodates the inbound and outbound transits of deep draft ocean going vessels. Its primary function is to facilitate the movement of cargo, and to lesser extent passengers to public and private marine terminals within the City of Jacksonville.

- ***Where is the Jacksonville Harbor Federal Navigation Project?***

The Jacksonville Harbor Federal Navigation Project is located in Duval County in Northeast Florida. It starts at the intersection of the Atlantic Ocean and the mouth of the St Johns River and extends landward for about 27 river miles.

The Jacksonville Harbor Timeline[1]

- **1822 – 1845**
  - Jacksonville became an official US Port of Entry in 1822. In the ensuing 23 years, the port grew in importance in the timber and lumber trades. By the turn of the century, 30 private terminals developed with operations transferring freight between ship and rail, and municipal docking facilities were built at Talleyrand in 1913. The St Johns River was deepened from 12.5' to 30' during this period.

- **1952 – 1965**
  - Throughout most of the 1950s, public docks were allowed to deteriorate after years of neglect. As a result, the post-war shipping boom bypassed Jacksonville. In 1957, the 1st shipment of automobiles moved through Jacksonville.
  - In 1963 the Florida Legislature created the Jacksonville Port Authority (JPA). The City transferred the Talleyrand municipal docks and land that was later renamed Blount Island. JPA was granted 1.5 mils of ad valorem taxing authority. Voters approved $25 million bond for improvements in 1964.
  - JPAs taxing authority is stripped and the City's allocation to the port is capped at $800,000 by the Florida State Legislature in 1965. The navigation channel was deepened from 30' to 34' during this time period.

- **1968 - 1999**
  - The City transferred ownership and management of airports to the JPA until 2001, when a separate authority was created to manage the airport facilities. The City Council withheld JPA's annual $800,000 capital improvement funds for 11 years starting in 1975.
  - JPA sold the eastern half of Blount Island to Offshore Power Systems, Inc. in 1972. The company announced plans to build floating nuclear power stations. However, these plans remained unrealized for economic reasons and the property was sold to Gate Maritime, Inc.
  - JPA facilities moved in excess of 5 million tons for the 1st time in 1992. Port Authority acquired the land for the Dames Point Terminal in 1998. By 1999, over 7.5 million tons of freight moved through the port marking the 9th consecutive year of tonnage growth. USACE deepened the St Johns River from 34' to 38'during this time frame.

- **2000 - 2012**
  - The terrorists' attacks on 9/11/2001 prompt the Florida Legislature to pass the Florida Seaport Security Act in an attempt to protect Floridian seaports against terrorism, crime, and vandalism in 2002.
  - JAXPORT launched its 1st strategic business plan emphasizing business growth and community economic impact. Also the JPA was divided into the Jacksonville Seaport Authority (JaxPort) and the Jacksonville Airport Authority (JAA).

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[1] Source- JAXPORT

- USACE deepened the navigation channel from the entrance to river mile 14.7 from 38’ to 40’ ~2003, and the US Navy purchased 270 acres of developed and undeveloped property for the loading of military equipment.

- Celebrity and Carnival cruise lines announced plans to begin regular service from Jacksonville in 2003. A year later, the 2124 passenger Carnival Miracle began its maiden voyage from Jacksonville[2].

- JAXPORT provided docking and logistical coordination for 4 out of 5 cruise vessels serving as floating hotels from Feb 2-7 for Super Bowl XXXIX in 2005[3].

- The same year, JAXPORT signed a 30 year lease agreement with Mitsui OSK Lines, Ltd, a Tokyo based logistics and ocean-transport Company. The agreement set the stage for the 1st Jacksonville – Asia container connection. One year later, JAXPORT launched port “jobs” website.

- The TraPac container terminal opened for business 1/12/2009 at Dames Point. The terminal is dedicated to handling container cargo going to and from ports in Asia. The federal navigation project at the St Johns River was deepened from 38’ to 40’ from river mile 14.7 to river mile 20 in 2010. The following year, an 8th grader from Arkansas[4] became the 1 millionth passenger to arrive for a cruise through the JAXPORT cruise terminal. The Yang Ming Milestone, the largest container vessel to call Jacksonville, arrived 1/31/2012 at the TraPac Container Terminal at Dames Point from Southeast Asia. The vessel has a breadth of 131’, a length of 1,000’, and a TEU capacity of 6,600 TEUS.

Why is the Jacksonville Harbor Federal Navigation Project being studied?

A convergence of international, national, regional / local concerns is driving the necessity to study channel improvements for the Jacksonville Harbor Federal Navigation Project. Each concern has a different economic dimension.

- **International Drivers:** Trade, efficient use of resources, transshipment, and port productivity are among the factors fueling the growth of containership size.
  - Trade: International population growth, increased living standards in developing countries, will result in more international trade.
  - Resources: Population and trade growth will increase competition for resources, fuel in particular. The newer larger vessels require fewer crew members and less fuel per delivered TEU.
  - Transshipment: Transshipment hubs have developed along equatorial routes that connect different maritime circulation systems. They allow the world fleet to be allocated more efficiently by allowing smaller vessels to service regional trades while larger vessels service longer distance trades.
  - Expansion of the Panama Canal
  - Containerization & Port Productivity: Increasing terminal productivity limit the amount of time the vessel spends idle.

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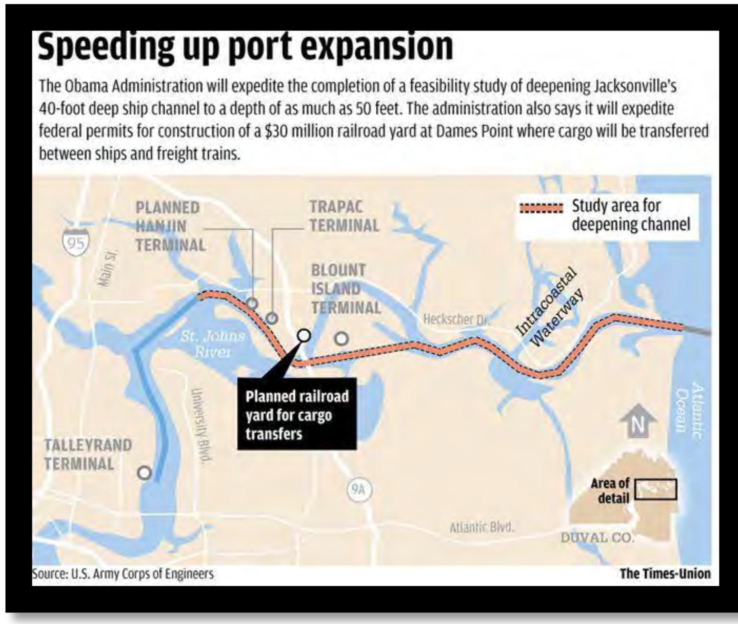
[2] Jessica Lynch, former US Army PFC, Iraq War POW, and Godmother of the Carnival Miracle christened the vessel hours before its 1st voyage to the Bahamas.

[3] The New England Patriots bested the Philadelphia Eagles by 3 pts in the 4th quarter.

[4] Emily Wilt- Source JAXPORT

- **National Drivers**: National initiatives to grow the economy, increase exports, and improve the country's infrastructure have placed increased focus on the Nation's seaports. Ports in Jacksonville, New York, Savannah, Miami, and Charleston are mentioned in the President's "We Can't Wait" initiative. In addition, changes in federal general navigation features that increase the net value of the national output of goods and services are in the federal interest according to ER 1105-2-100.



- **Regional/Local Drivers:** Government and business leaders at the state and local level along with the local sponsor have expressed interest in growing the local economy by making Jacksonville a hub for logistical activity. As a result JAXPORT has aggressively sought to attract the business of major ocean carriers. This has resulted in the development of the TraPac Container Terminal in 2009 and the acquisition of additional East-West container services.

  However, the vessels servicing the long distance East-West container trade are transitioning to Post-Panamax sizes for the rationale stated above. The federal navigation project is incapable of accommodating the 2nd generation of post-panamax ships in its current configuration.

1.2 THE OBJECTIVE
The purpose of this study is to develop and evaluate alternate plans to address navigation concerns and improve navigation in Jacksonville Harbor. The objective of the general reevaluation report is to investigate and recommend solutions to the water resources problems at Jacksonville Harbor.

1.3 THE OPTIONS
Alternatives evaluated as possible solutions range from doing absolutely nothing to deepening up to 50' in conjunction with widening and additional turning basins.

1.4 THE DECISION CRITERIA (ECONOMICS)
This appendix will only describe the economic dimension of the alternative selection process. The benefits must be in excess of the costs, and the NED plan will be the plan that most reasonably maximizes net National Economic Development (NED) benefits. An NED benefit is defined as a positive change in the national value of goods and services.

Economic benefits have been measured as the difference in the life cycle cost of commodity movement between the possible future in which nothing is done, and the possible futures in which something is done. The life cycles evaluated encompass the time frame starting in 2020 and ending in 2070. All life cycle cost and benefits will be compared at 2013 price levels using the FY2013 Federal Water Resources Discount Rate of 3.75%.

The economic analysis is focused on the 1st 13 river miles of the federal navigation project (Segment-1) to limit project costs and environmental impacts. There is significant containerized, dry bulk, liquid bulk, general cargo, and cruise passenger traffic moving through Jacksonville Harbor. However, the economic analysis focused on containerized and dry bulk cargoes to synergize the level of detail with the cargo moving within the cargo footprint. Given that container cargoes represent the overwhelming majority of benefits for Segment-1 it was decided that container and to a lesser extent, dry-bulk cargoes would represent the focal point for the analytical effort.

1.5 THE DATA

The data collection and compilation effort was used to develop a picture of the existing condition and as inputs to the economic modeling effort. Ultimately, these data was used to synthesize the knowledge from which the cost of commodity movement could be estimated given multiple channel configurations. It was collected from PIERS, St Johns River Harbor Pilots Association, Lloyds-Seaweb, Waterborne Commerce Statistics Center, JAXPORT, and Drewry. It is important to note that different data sources are collected for a variety of reasons, using a variety of methods. As a result, there are inconsistencies within the data. However it is not believed that these inconsistencies will impact the characterization of the existing condition. Commodity quantities are described in metric tonnes and TEUS for analysis, modeling and reporting purposes. Data sources and uses are described in the following sections.

1.5.1 PIERS

This data covers the time frame from 2006 to around April 2011 and includes cargo movement dates, vessels names and identifiers, sailing drafts, commodity types, sources, destinations, and quantities. Commodity units are defined in metric tonnes and TEUS. It is used to characterize the sources, destinations, trade concepts, and parcel sizes per vessel movement. It is also used to inform the identification of trade routes.

1.5.2 ST JOHNS RIVER HARBOR PILOTS ASSOCIATION

This data includes vessel movements, terminals visited, arrival and departure dates, times, and sailing drafts between 2008 and April 2011. The data also include prior and next vessel destinations. The information drawn from the data includes fleet characterization, time spent at the dock, and existing condition vessel sailing draft distribution. In addition, the data also informs the trade route analysis.

1.5.3 WATERBORNE COMMERCE STATISTICS CENTER (WCSC)

This data covers the time frame from CY 2005 to CY 2009 and includes cargo movement dates, vessels names and identifiers, sailing drafts, commodity types, sources, destinations, terminals visited, and quantities in short tons. It is used to supplement commodity sources and destinations, fleet, tonnages, terminal visitation, and sailing draft.

1.5.4 WCSC ENTRANCES AND CLEARANCES

This data is available from the WCSC website and provides data on vessel movements in and out of US ports between CY 2007 and CY 2010. Data included is vessel identifiers (IMO #s) arrival and departure dates, sailing drafts, and prior and next port locations. These data was used primarily to construct sailing draft distributions for vessel classes by trade route.

1.5.5 JAXPORT

This data includes arrival and departure dates and times by vessel at each JaxPort terminal. It was used to determine the amount of time vessels spend at each dock.

1.5.6 DREWRY MARITIME RESEARCH

Drewry was used to get information on trade routes, services and itineraries.

1.5.7 LLOYDS-SEA WEB

Lloyds Sea web was used to gather data on vessel dimensions and capacities by IMO number. Vessel dimensions are measured in feet and capacity is measured in metric tonnes and TEUS.

1.6 LAYOUT OF THE APPENDIX

- **Introduction**

The introduction to the appendix was geared toward providing the reader with an overview of the context within which the economic analysis was conducted. Included was a brief history of the port, the objective of the study, and the role of the economic analysis in support of the study. A description of the data sources and their use, and an overview of the appendix is also provided.

- **Existing Condition**

This section of the appendix describes the economic study area boundaries, the people within those boundaries, their economic activities, and the transportation infrastructure used to meet the demand for freight transport. It is designed to establish the components of trade within the hinterland, and the linkage between those components and the port facilities at Jacksonville Harbor. The 1st portion of this section describes the hinterland and the infrastructure supporting freight movement. The second portion characterizes freight movement through the port in the existing condition.

- **Methods, Forecasts, & Assumptions**

This section is used to describe the assumptions, methods, and forecasts used to transition from the existing condition to the future possibilities. This section explores the link between the alternatives, and the commodity and fleet forecasts, and the components of transportation costs.

- **Future Possibilities**

This section of the economics appendix explains the results of the economic modeling effort with respect to the future without project condition and the alternatives.

1.7 THE LINGO OF THE APPENDIX

- **Future Possibilities** – The universe of possible futures made up of the future without project condition and the future with project condition alternatives.
- **Primary Benefit** – An economic benefit that informs plan formulation
- **Incidental Benefit** – Economic benefit caused by the realization of the primary benefit.
- **Units of Measurement**
  - Metric Tonnes
  - TEUS – twenty foot equivalent units
  - Nautical Miles – used to define the distances of voyages/ trade routes and river miles.
  - Model Year -
- **Vessel**
  - Containerships
    - SPX1 – Sub-panamax vessel with a capacity of 1500 TEU or less
    - SPX2 - Sub-panamax vessel with a capacity of 1500 TEU or less
    - PX1 – Panamax vessels with a design draught ~ 40'
    - PX2 – Panamax vessels with a design draught ~ 42-44.5'
    - PPX1 – Post-panamax vessels with a beam of around 131-138'
    - PPX2 – Post-panamax vessels with a beam of 141'-146'
- **Trade**
  - Trade Region – A region in the world representing a source and/or destination for cargo
  - Trade Route / Route Group – Linkage between one or more trade regions
  - Itinerary – A series of seaports that constitute a trade route
  - Service – A predetermined number of scheduled stops (port calls) for the purpose of providing "service" to the seaports along the itinerary.
  - Port Call – An arrival to and departure from a seaport for the purpose of loading and or unloading cargo
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2 THE EXISTING CONDITION….

2.1 ECONOMIC STUDY AREA

The purpose of this section is to establish the linkages between the study area and the project area, as well as provide a description of the port facilities and general navigation features. This will be accomplished by defining the spatial boundaries of the hinterland, establishing the demographic and economic conditions within those boundaries, and the how freight is distributed throughout the hinterland from the port facilities to the distribution centers.

2.1.1 COMPONENTS OF TRADE

For there to be demand for freight transportation, the basis for trade should be established. Trade requires economic activity, population, and infrastructure connectivity. Thus, main purpose of this section is to describe the population, economic activity, and infrastructure connectivity of the hinterland.

2.1.1.1 DOMESTIC HINTERLAND BOUNDARIES

The intent of this hinterland analysis is to identify the population anticipated to be served by Jacksonville Harbor. Hinterland spatial boundaries were determined qualitatively based on the relative distance of population centers from surrounding seaports while considering each seaport's cargo volume. The relationship between the port of entry/exit, the hinterland, and the cargo could be conceptualized as "freight density", or cargo consignments per unit of hinterland area. Cargo is received through the seaport and dispersed throughout the hinterland. As the distances from seaport "A" increase, the number of cargo consignments per unit of hinterland area attributable to seaport "A" decrease. Hinterlands effectively overlap when the cargo consignment is just as likely to come from seaport "A" as it is to come from seaport "B". Other factors to consider are the distribution of trade lanes, cargo volume, and access to land-locked population

Figure 2-1: South Atlantic Seaports

centers. It must be noted that defining a hinterland will always be an over-simplification of reality given the diffuse nature of trade and human economic behavior[5].

Jacksonville Harbor is bounded by Savannah to the north and Port Canaveral, Port Everglades and Miami to the south. Pensacola and Panama City provide waterborne cargo access to the Floridian Panhandle. Tampa, a major port for bulker cargoes, provides access from the Gulf of Mexico to central Florida. In terms of major container cargo seaports, Savannah Harbor accounts for the largest share of cargo to the South Atlantic and has an expansive hinterland. According to Port Everglades and Miami service the southern half of Florida.

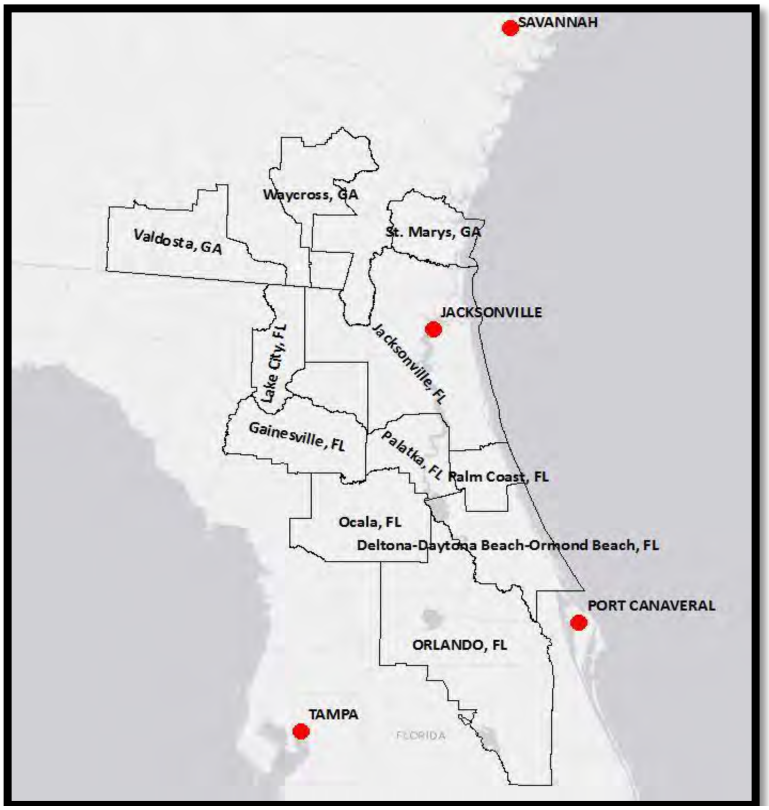


Figure 2-2: Hinterland Boundaries by MSA

The next step in defining the hinterland is to roughly locate the population centers that fall between these seaport locations. Major population centers identified were the following metropolitan statistical areas:

- Deltona-Daytona-Ormond, FL
- Gainesville, FL
- Jacksonville, FL
- Ocala, FL
- Palm Coast, FL
- Valdosta, GA
- Orlando[6]

Jacksonville is the largest city in the U.S. in terms of area. Other relevant political boundaries consist of Alachua, Baker, Bradford, Duval, Bradford, Clay, Columbia, Union, Flagler, Putnam, Hamilton, and Nassau counties.

2.1.1.2 Population

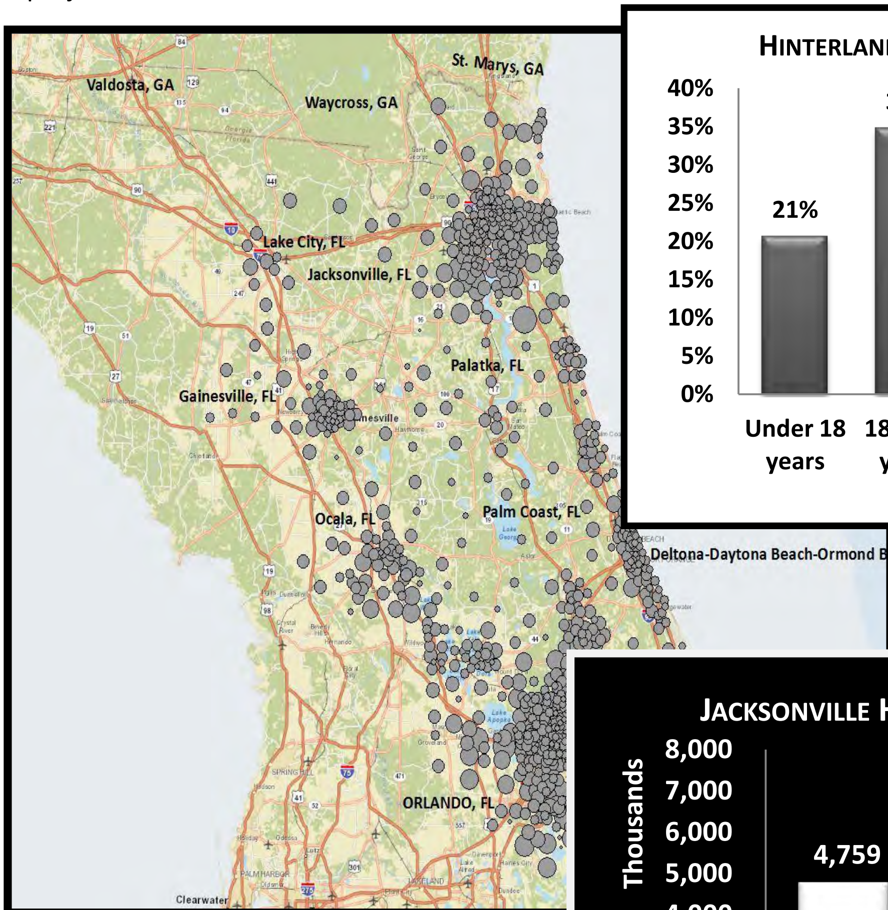
After the hinterland boundaries were determined, the population within the hinterland was characterized to assess the need for freight transport throughout the period of analysis. As of 2012, the hinterland population was estimated to be at nearly 4.8 million. Table 2-1 provides greater detail on the hinterland population.

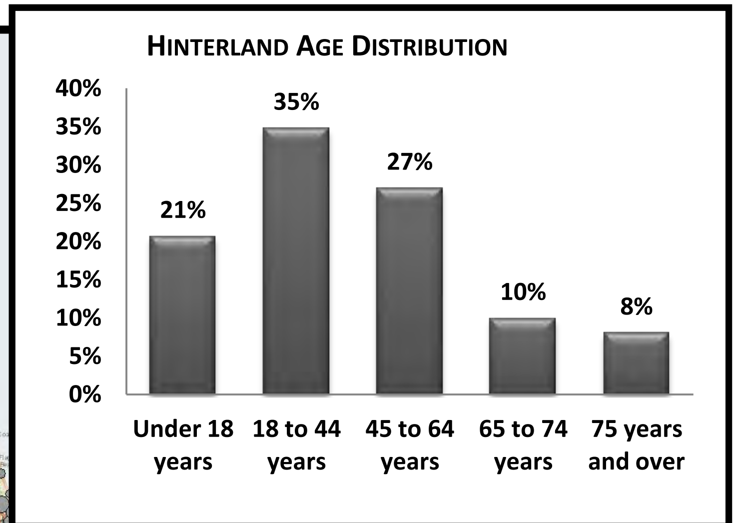
Table 2-1: Jacksonville Harbor Hinterland Population

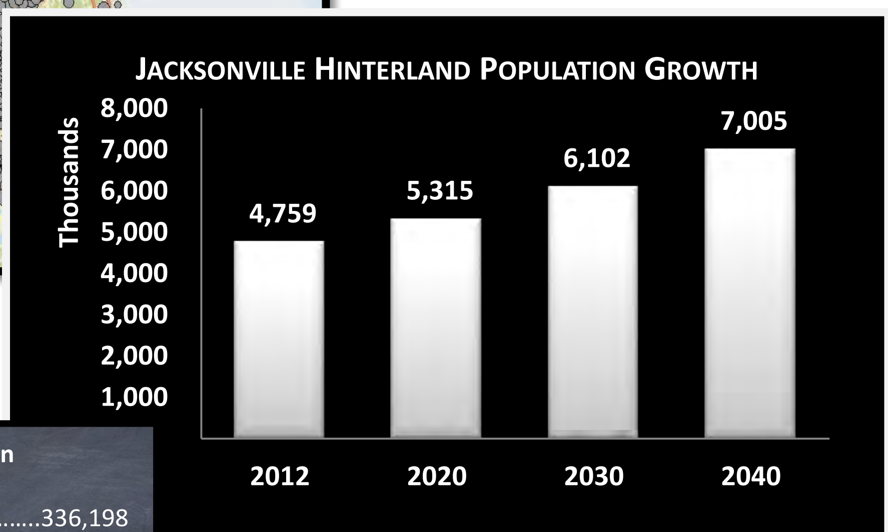
Year	Hinterland Population	Source
2000	3,878,730	2000 Census
2010	4,620,399	2010 Census
2011	4,683,934	US Census Estimate
2012	4,759,316	US Census Estimate

[5] According to HIS Global Insight, cargo from Jacksonville travels as far as Alabama and Georgia.
[6] The Orlando portion of the hinterland overlaps with Port Everglades, Miami, Tampa, and Port Canaveral.

Figure 2-3 and illustrates the distribution of population over space / combined statistical area and by age group. Most of the population is clustered around Jacksonville, Gainesville, Daytona, Ocala, Orlando and Lake City. Over 62% of the population is between the ages of 18 to 64.
According to the Global Insight forecast, a compound annual growth rate of 1.39% was projected for the population of Florida, Georgia, and Alabama. This growth rate was applied to the hinterland made up of the aforementioned CSAs. The hinterland population is anticipated to grow from 4.7 million in 2012 to 5.3 million by 2020, and over 7 million by 2040, Figure 2-3 provides greater detail on the population projections







2012 - Combined Statistical Area Population

- Gainesville-Lake City, FL..336,198
- Jacksonville – St. Mary's Palatka, FL-GA............1,502,515
- Orlando-Deltona-Daytona Beach, FL..................2,920,603

Total: 4.75 M

Figure 2-3: Hinterland Population: Demographics and Projections

2.1.1.3 ECONOMIC ACTIVITY

This section describes the economic activities of the hinterland population. The previous section provided a brief overview of the population including some demographic information and an estimate of future population.

- **Hinterland GDP by MSA**

The areas that make up the Jacksonville Harbor Hinterland as described above had a combined real GDP of $169 billion in chained 2005 dollars as of 2011. In 2001 real GDP grew from $140 billion in 2001 to a high of nearly $185 billion in 2007 before falling to a low of $167 billion in 2009. The Jacksonville and Orlando MSAs make up roughly 85% of hinterland economic output. The distribution of output by MSA is as follows:

- Palm Coast, FL: .7%
- Ocala, FL: 3.8%
- Gainesville, FL: 5.1%
- Deltona-Daytona-Ormond Beach, FL: 6.6%
- Jacksonville, FL: 31.2%
- Orlando-Kissimmee-Sanford:, FL: 52.5%

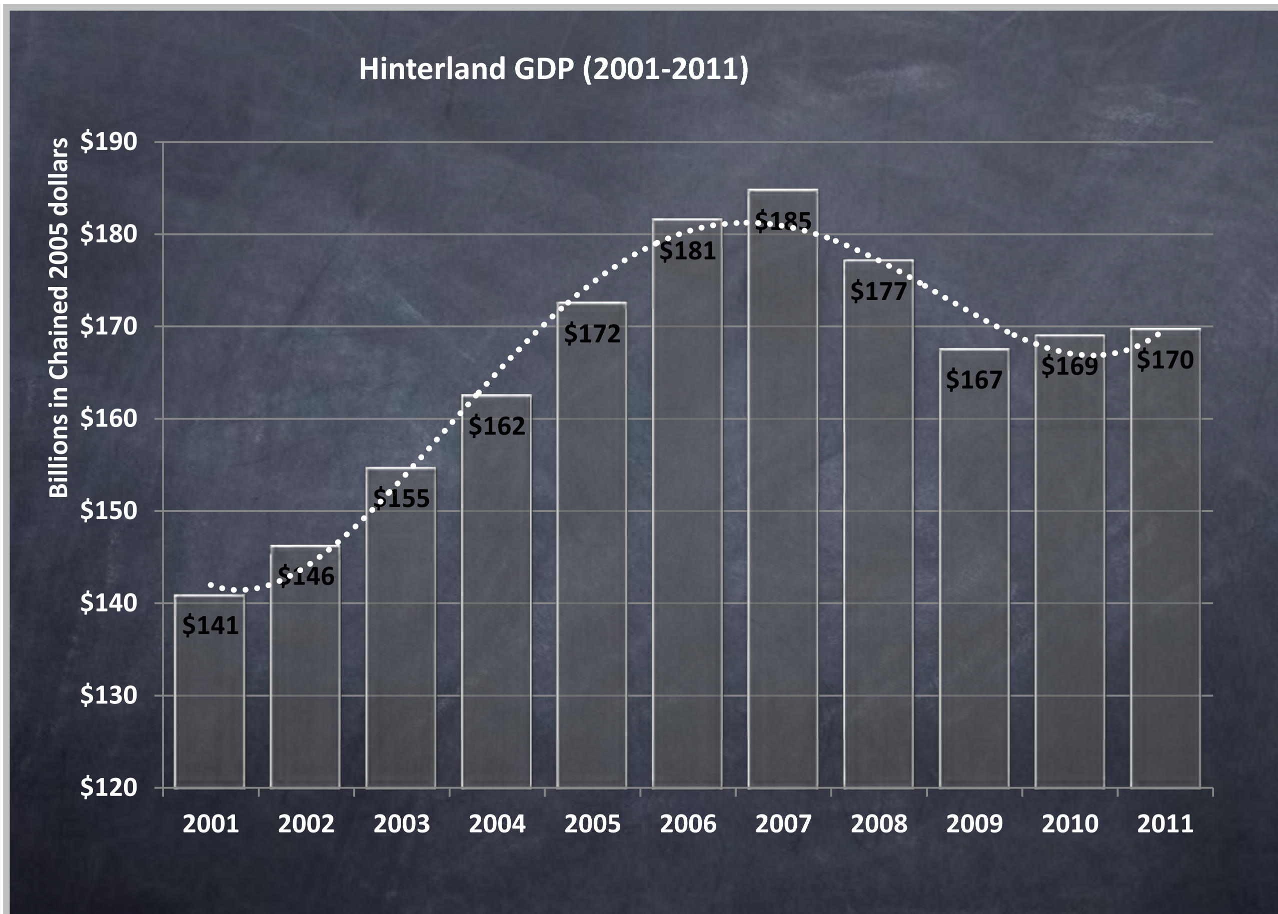


Figure 2-4: Hinterland GDP (2001-2011)

⌗ GDP: Private & Government

Private industry makes up 89% of total output in the hinterland, while federal, state, and local government accounts for the remainder. Roughly 87% of the private sector economy is service based, with goods accounting for the remaining share. Significant economic sectors include finance and insurance, retail and wholesale trade, professional services, and manufacturing.

Industry Category	%	Cumulative %
Real estate and rental and leasing	17.2%	17.2%
Government	11.7%	28.9%
Retail trade	8.1%	37.0%
Finance and insurance	7.6%	44.6%
Professional, scientific, and technical services	6.3%	50.9%
Manufacturing	5.4%	56.3%
Health care and social assistance	5.1%	61.4%
Information	5.0%	66.4%
Administrative and waste management services	4.3%	70.8%
Accommodation and food services	3.8%	74.6%
Construction	3.7%	78.3%
Wholesale trade	3.7%	81.9%
Transportation and warehousing	2.9%	84.8%
Arts, entertainment, and recreation	2.5%	87.3%
Management of companies and enterprises	1.2%	88.5%
Utilities	0.6%	89.1%
Educational services	0.5%	89.7%

Figure 2-5: Hinterland GDP % Distribution

2.1.1.4 Distribution Network

This section of the appendix describes the network linking the population and distribution centers to each other and the port facilities.

2.1.1.4.1 Distribution Centers

Distribution centers are specialized buildings used to store goods for delivery to retailers, wholesalers, or consumers. They represent an integral piece to the supply chain in that they allow a large number of products to be consolidated in one location to be shipped out in smaller consignments

Major distribution centers within the hinterland include:

Company	Location	Open	Sq. Feet
Bridgestone Firestone	Cecil Commerce Center	2008	1,000,000
Wal-Mart	Baker County	2002	1,000,000
Coach Leather	Jax Intl.	2008	817,000
Samsonite	Imeson Industrial Park	2008	817,000
Sears Logistics	Northpoint Industrial Park	2008	812,000
Unilever	Westlake Industrial Park	2008	772,000
Dr. Pepper/Snapple	Westpoint Trade Center	2008	601,000
Georgia Pacific	Westlake Industrial Park	2008	546,000
BJs	Westlake Industrial Park	2003	480,000
Mercedes Benz	International Tradeport	2009	400,000
Hanes	Northpoint Industrial Park	2007	360,000
Volkswagen	Perimeter West	2008	260,000
BMW	Westside Industrial Park	2007	213,000
Michaels Arts and Crafts	West Jacksonville	2007	207,000
PSS World Medical	Westside Industrial Park	2007	198,000
Volvo North America	Westside Industrial Park	2006	175,000
Owens and Minor	Westside Industrial Park	2007	137,000
Osh Kosh	Imeson Industrial Park	2008	130,000
Johnstone Supply	Westside Industrial Park	2007	120,000
Hillman Group	Northpoint Industrial Park	2006	98,000
D and H Distributing	Westside Industrial Park	2007	80,000
Tweeter/Sound Advice	Northpoint Industrial Park	2008	70,000

Figure 2-6 illustrates the location of distribution centers within the hinterland. As shown in Figure 2-3 and Figure 2-6, the distribution centers tend to be clustered within close proximity of major population centers, and interstate highways.

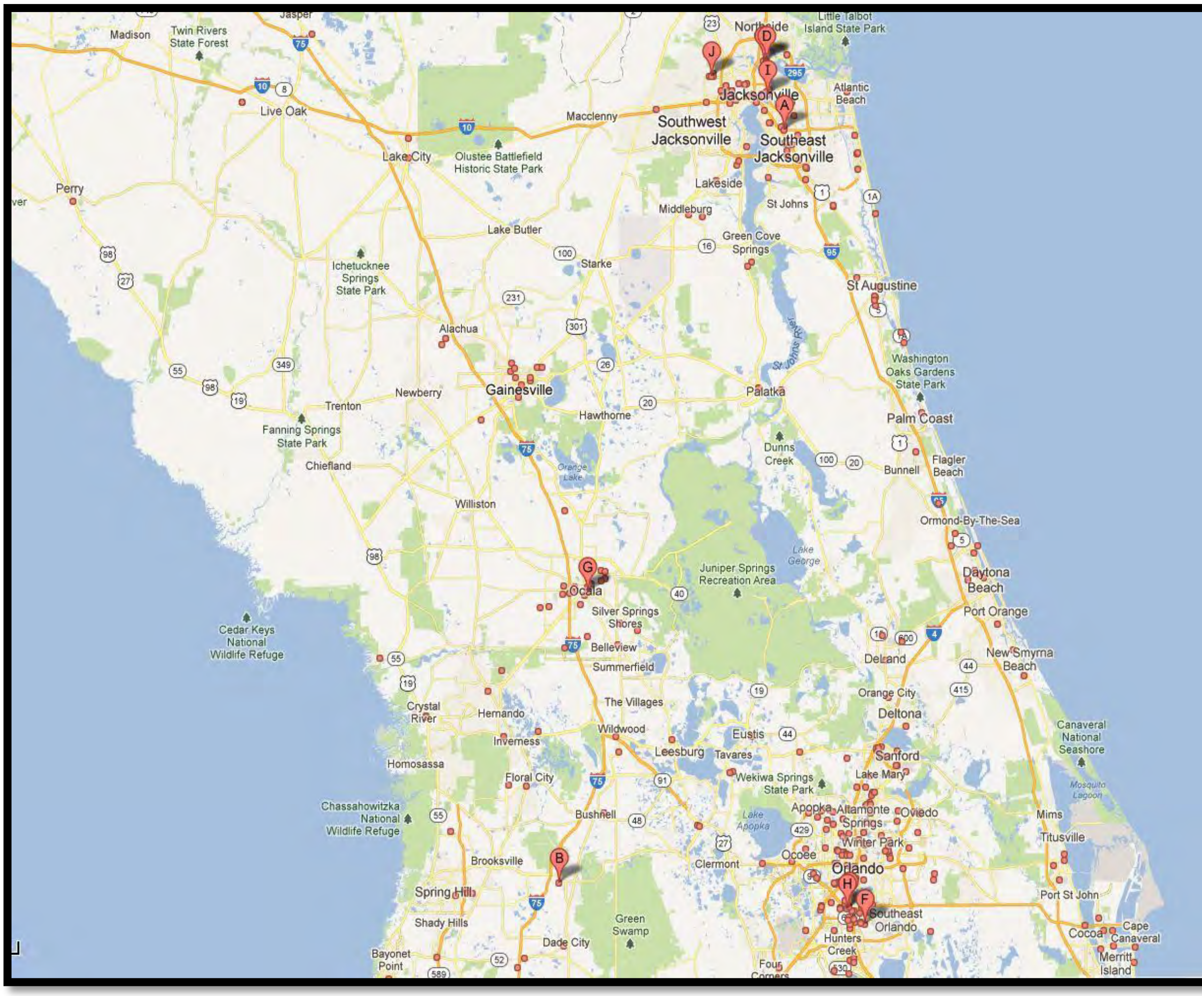


Figure 2-6: Distribution Centers

2.1.1.4.2 *Transportation Infrastructure*

Transportation infrastructure refers to the infrastructure used to reduce the resistance associated with moving freight and people. In the context of this analysis, this infrastructure consists primarily of roads, rail, seaport facilities, and the general navigation features that will be the focus of this analysis.

2.1.1.4.2.1 *Interstate Roads*

Trucking is the mode of freight movement most likely to be used to serve the immediate hinterland. Road is typically used to move freight within a 700-800 mile range. Interstate roads are the primary piece of infrastructure serving to connect the hinterland population to its social, cultural, and economic activity. Most of the hinterland population, distribution centers and retail outlets are quite close to a major interstate artery. The major interstates consist of the following:

- I-10: I-10 stretches across the Northern Florida from Jacksonville connecting the Floridian East Coast with the Gulf Coast States. It provides hinterland connectivity from Jacksonville to Lake City.
- I-95: I-95 connects the northeast corner and southeast corners of the hinterland. This artery connects Jacksonville, St Augustine, Flagler Beach, Ormond by the Sea, and Daytona Beach.
- I-75: I-75 forms the western edge of the hinterland, connecting Lake City, Gainesville, and Ocala.
- I-4: I-4 stretches from I95 across the central part of the state through Orlando to Tampa, essentially connecting the Atlantic and Gulf Coasts of Florida. I4 connects Daytona Beach to Orlando and forms the southern boundary of the hinterland.

2.1.1.4.2.2 Rail Connections

Principle rail service providers for the hinterland include Florida East Coast (FEC) and CSX.
FEC operates 351 miles of track on the Floridian East Coast with connections to CSX and Norfolk Southern in Jacksonville. Stops on the route include Jacksonville, Miami, Ft Lauderdale, Ft Pierce, and Atlanta.

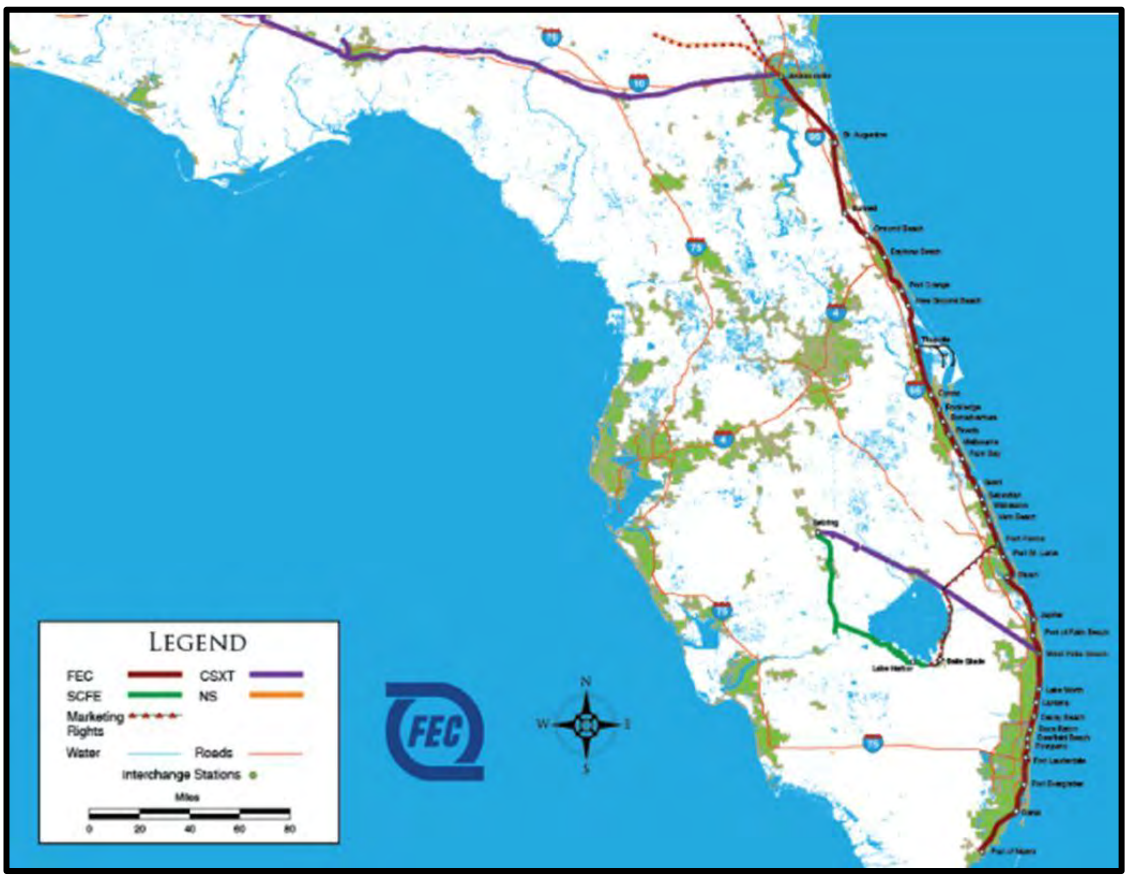


Figure 2-7: FEC Rail Lines

CSX has its corporate headquarters in Jacksonville, where it operates and maintains 2,800 miles of track and 3,000 public and private grade crossings in Florida. Rail service provides access to an expanded hinterland, because past 700 – 800 miles, trucking cost increase dramatically. Rail service tends to become more cost effective than trucking when the freight needs to be moved over land between 1,900 – 2,000 miles.

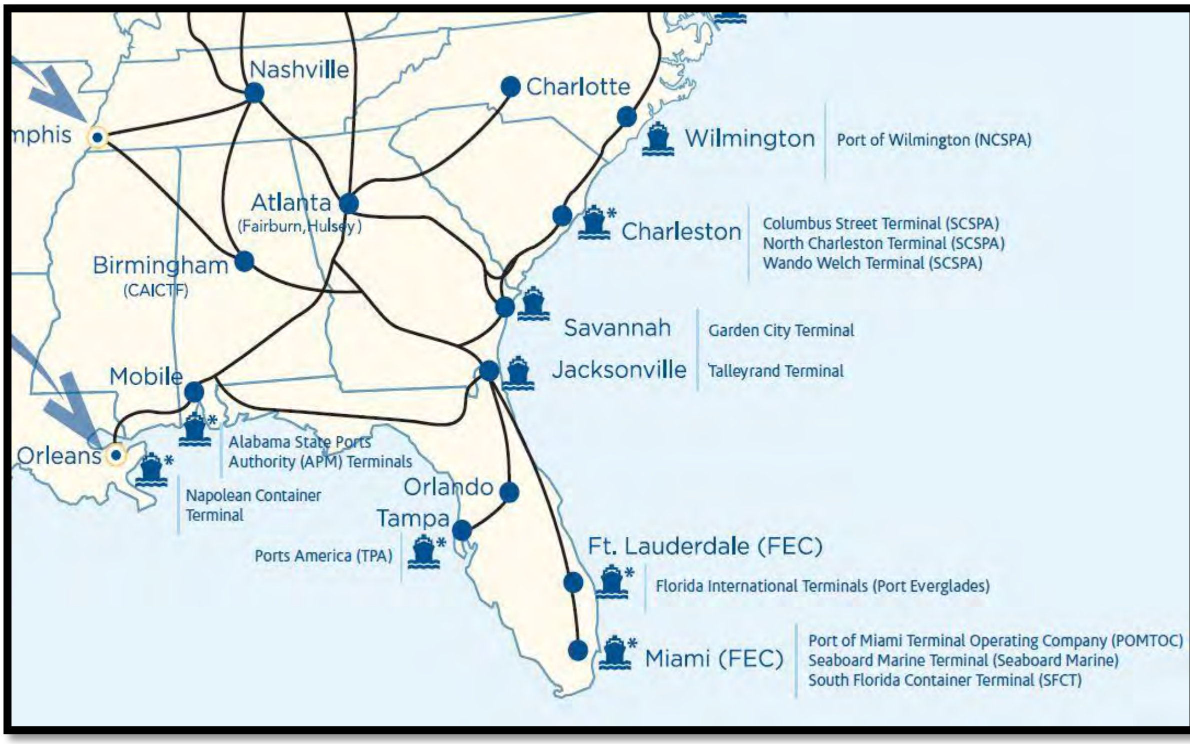


Figure 2-8: CSX Terminal Connections

2.1.1.5 ROAD AND RAIL CONNECTIONS TO THE PORT FACILITIES

I-295 is within a mile of the Blount Island, and Dames Point marine terminals, minutes from I-95 and I-10, and roughly hour from I-75. The Blount Island terminal has on-dock rail, which is served by CSX. JAXPORT and CSX are in the process of developing an intermodal container transfer facility to allow containers to be transferred between vessels and trains at the Dames Point terminal. The Talleyrand Marine Terminal is located 25 minutes from the FEC intermodal ramp, has direct switching service for Norfolk Southern and CSX railroads. Talleyrand is also located within minutes of I-95 and I-10.

2.1.2 RECAP

This section covered the delineation of the primary hinterland boundaries and the past present, and projected population within those boundaries. It went on to develop the spatial distribution of the population, their economic activities, and events. The section ended with an assessment of the major road and railway links that connect the population centers and facilitate the flow of commerce endogenous and exogenous to the hinterland. Finally a description of how the major road and railway linkages connect to the port facilities was provided. The key points of this section are as follows:

- Hinterland boundaries are an abstraction used to get a sense of freight diffusion throughout the domestic hinterland. Savannah, the largest container port in the South Atlantic in terms of volume has the largest hinterland, with cargoes reaching as far into Florida as Tampa. The main purpose is to identify that segment of the population most likely to generate demand for freight transport from the port being studied.

- The core hinterland for Jacksonville Harbor is Northeast Florida, and Southeast Georgia.

- Hinterland population is anticipated to grow from 4.7 million in 2012, to over 7 million by 2040.

- As of 2011, the hinterland had a combined GDP of $169 billion in chained 2005 dollars, and an average unemployment rate of 8.3%. The primary economic sectors include financial services, tourism, professional services, and trade (retail and wholesale).

- Hinterland population centers are connected and in a sense, bounded by I-10, I-95, I-4, and I-75. I-10 and I-95 are within minutes of the major JAXPORT marine terminals at Jacksonville Harbor.

- CSX and FEC provide railway connections that link the Jacksonville Harbor hinterland to not only the hinterlands of other seaports, but to inland intermodal facilities within the interior of the country. Blount Island and Talleyrand have on-dock rail, and an intermodal container transfer facility is being developed at Dames Point.

2.1 LOCAL SERVICE FACILITIES (LSF)S & GENERAL NAVIGATION FEATURES (GNF)

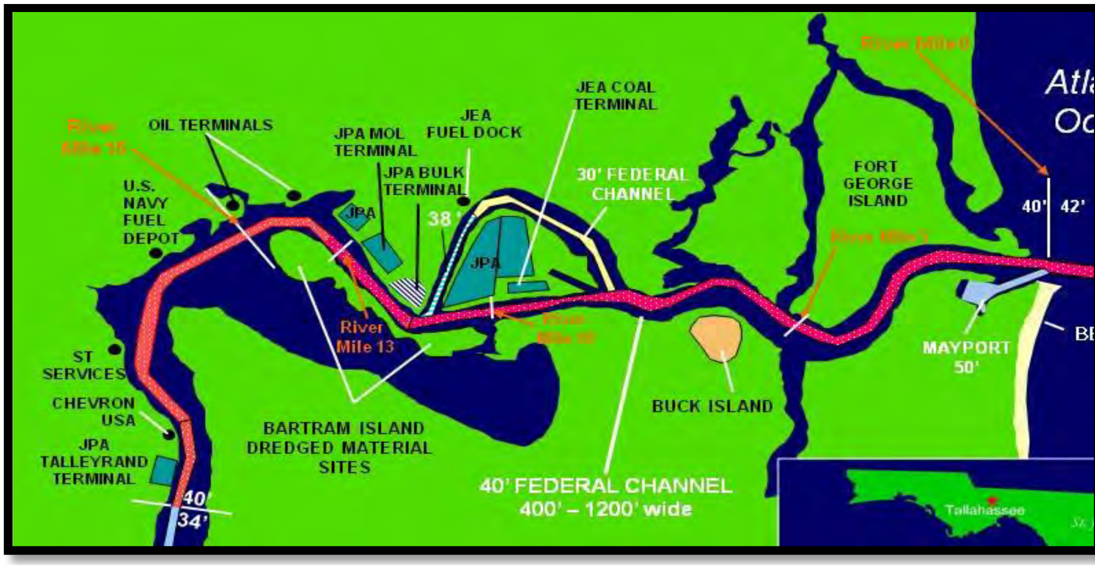


Figure 2-9: Overview of the Project Area

This section of the appendix is used to characterize the relevant marine terminal facilities and general navigation features (GNFs) operating in Jacksonville Harbor in terms of their location and function. While the GNFs and LSFs are distributed over 24 miles of the navigation channel, the primary focus of the analysis is on the 1st 13 river miles with the exception of the Talleyrand Marine Terminal.

2.1.1 JACKSONVILLE HARBOR MARINE TERMINALS

Marine terminals represent the facilities where the mode of transportation for freight and people is transferred from land borne to waterborne and vice versa. As mentioned previously, Jacksonville Harbor is made up of an amalgamation of public and private marine terminals distributed throughout the 1st 20 plus miles of the St Johns River. These terminals will be characterized in the following sections.

2.1.1.1 BLOUNT ISLAND MARINE TERMINAL

Blount Island Marine Terminal is located 9 nautical miles from the channel entrance and has 6,000 ft of berthing space. The terminal encompasses 754 acres and handles heavy lift, containers, Ro/Ro, breakbulk and liquid bulk cargoes. In addition, Blount Island is one of the largest import/export centers in the United States.

Figure 2-10: Blount Island Marine Terminal

Table 2-2: Carriers Calling Blount Island

CARRIER	REGION	FREQUENCY/SERVICE
American Roll-On Roll-Off Carrier (ARC)	Mediterranean/Middle East	Twice Monthly
Atlantic Container Line (ACL)/Grimaldi	Africa	20 Days
China Shipping	Asia	Weekly Container
CMA CGM	Far East/Europe/S. Africa	Weekly Container
Eukor	West Africa, South Africa, Singapore, Far East	Twice a month
Frontier Liner Services	Caribbean/North Coast South America	Weekly Container, Multi-cargo
Grieg Star Shipping	Europe/Mediterranean/	Inducement/ Breakbulk/Project/Multi-cargo
Gulf Africa Line	South Africa/Mexico/US Gulf	20 Days
Hoegh Autoliners	Africa/Asia/Europe/Middle East	6 days (Mideast) RoRo
Horizon Lines	Caribbean/Puerto Rico	Weekly Container
K-Line	Africa/Europe/Mediterranean/South America/Europe	Weekly RoRo
Liberty Global Logistics	USEC & Gulf to Mediterranean, Red Sea, India, Pakistan	35 Days RoRo
Mitsui O.S.K. Lines/MOL Bulk	Mexico/North Coast South America/East Coast South	Bi-Monthly RoRo
Nordana Line	West Africa/Mediterranean	Monthly
NYK Line (NA) Inc.	Asia/Europe/Middle East/South America	12 Days (Carib/C Am)
Sea Freight Line	Caribbean/Central & South America	Weekly Container, Multi-cargo
Sea Star Line	Caribbean/Puerto Rico	Weekly Container, LoLo,
Trailer Bridge	Caribbean/Puerto Rico/Dominican Republic	Twice Weekly RoRo & Container
United Arab Shipping Company	Asia	Weekly Container
Wallenius Wilhelmsen Lines	Asia/Australia/Europe/Mediterranean/Middle East	Bi-Monthly RoRo

2.1.1.2 ST JOHNS RIVER COAL TERMINAL

St Johns River Coal Terminal is located on Blount Island just east of the JPA Blount Island terminal facilities. Its primary purpose is to receive coal shipments for power plant consumption at the St Johns River Power Park. The terminal consists of 1 berthing area, discharge facilities, and a 2-3 mile conveyor to ferry the coal from the terminal to the St Johns River Power Park facility.

The JEA Northside Generating Station dock is located at the north end of the Blount Island Channel and is used to receive fuel oil and petroleum coke for power plant consumption.

2.1.1.3 DAMES POINT MARINE TERMINAL

The Dames Point Marine Terminal, about 10 nautical miles from the Atlantic and is used to move containers and dry bulk cargoes. In addition, the cruise ship terminal also operates out of Dames Point. In 2009, the MOL TraPac terminal, JaxPort's newest facility began operations servicing East-West trade lanes. The TraPac terminal features new port infrastructure, including roadways, terminal buildings, two 1,200-foot berths and six Post-Panamax container cranes. The terminal has 4 berths and an annual throughput capacity of around 1 million TEUS per annum. JAXPORT and CSX are developing an intermodal container transfer facility, or ICTF, at Dames Point terminal to transfer containers between vessels and trains.

Figure 2-11: Dames Point Marine Terminal-MOL TraPac

Table 2-3: Carriers Calling Dames Point

CARRIER	REGION	FREQUENCY/SERVICE
APL	Asia	Weekly Container
COSCO	Asia	Weekly Container
Evergreen Shipping	Asia	Weekly Container
Hanjin Shipping	Asia	Weekly Container
Hyundai Merchant Marine	Asia/Northern Europe	Weekly Container
MOL (America) Inc.	Asia	Weekly Container
Yang Ming	Asia	Weekly Container

2.1.1.4 TALLEYRAND MARINE TERMINAL

The Talleyrand Marine Terminal is 21 nautical miles from the Atlantic Ocean and handles containers, automobiles, and liquid bulk. This 173-acre terminal has 4,780 linear feet of berthing space and 40 ft of depth. The terminal handles containerized and break-bulk cargoes, imported automobiles and liquid bulk commodities such as turpentine and vegetable oil. Other cargoes include steel, lumber and paper, and a variety

Figure 2-12: Talleyrand Marine Terminal

of frozen and chilled goods. Talleyrand is equipped with four container cranes, on-dock rail and 160,000 square feet of transit shed space capable of handling cargo in refrigerated, freezer or ambient conditions. Additionally, a 553,000-square foot warehouse stores a variety of cargoes, including rolls of fine and specialty papers, magazine papers and newsprint. The Talleyrand terminal also offers two 50-LT capacity rubber tired gantry cranes, both of which straddle four rail spurs totaling 4,800 linear feet (1,463 m). Talleyrand's on-dock rail facilities are run by Talleyrand Terminal Railroad, Inc., which provides direct switching service for Norfolk Southern and CSX railroads.

Table 2-4: Carriers Calling Talleyrand

CARRIER	REGION	FREQUENCY/SERVICE
Aliança Lines, Inc.	East Coast South America	Weekly Container
Crowley Liner Service	Caribbean/Puerto Rico, Central America	Weekly Container
CSAV	South America	Weekly Container
Great American Lines (GALI)	Asia	56 Days
Hamburg Süd N.A.	Caribbean/Central America/East Coast South America/North	Weekly Container
Mediterranean Shipping (MSC)	Africa/Asia/Caribbean/Central America/Europe/Middle East/	Weekly Container
Spliethoff (Balticarrier)	Europe/Baltic/St. Petersburg	Break-bulk/Container

2.1.2 OTHER TERMINALS

In addition to the terminals mentioned above, there are also major privately owned terminals that ship and receive significant liquid and dry bulk cargoes for power generation, construction, or petrochemical distribution.

2.1.2.1 PETROLEUM PRODUCT TERMINALS

Marine terminals that provide petrochemical terminal storage and distribution services are operated by BP/Amoco, Amerada Hess, Chevron, NuStar, and TransMontaigne. These facilities are located at Broward Point Turn, Chaseville Turn, and the Long Branch Range sections of the navigation channel. The terminals are used to receive petroleum products by tanker and barge, and in some cases ship diesel fuel and other chemicals. None of these terminals are located within the portion of the navigation channel currently being studied for deepening and widening.

2.1.2.2 OTHER FACILITIES:

In addition, there are other facilities that receive gypsum, aggregate, asphalts, slag, and cement located at the Chaseville Turn, and at the south end of Terminal Channel. Recently, the Keystone Coal Company has built a new terminal at the old Jefferson Smurfit facility. It has been suggested that the facility will handle 3 million tonnes of coal per year. However, there was no data available on coal volume at the terminal at this time.

Table 2-5: JAXPORT Marine Facilities

	Blount Island	Talleyrand	Dames Point
Location	9 nautical miles (16.7km) from the Atlantic Ocean	21 nautical miles (38.9km) from the Atlantic Ocean	10 nautical miles (18.5km) from the Atlantic Ocean
Terminal Area	754 acres	173 acres	Total Area — 585 acres (TraPac terminal = 158 acres)
Use	Container, Ro/Ro, Breakbulk and General Cargo	Container, Ro/Ro, Break-bulk, Liquid Bulk and General Cargo	Container, Bulk, Cruise
Facilities	240,000 sq ft of transit shed 90,000-sq-ft container freight station	160,000-square foot warehouse with 2.2 million cubic feet of cold storage 553,000-square feet of transit shed	
General Berths	#20 — 754 linear ft #22 — 600 linear ft #30 — #35: 5,240 linear ft	#3 — 680 linear ft #4 — 800 linear ft #5 — 800 linear ft #6 — 800 linear ft #7 — 800 linear ft #8 — 900 linear ft	#10 — 1,289 ft #16 — 1,200 ft #17 — 1,200 ft #18 — 1,322 ft
Apron Width	#20: 111.5 ft #22: 80 ft #30-35: 80 ft in front of transit shed; 150 ft elsewhere	80 ft	#10: 80 ft #16,17: 150 ft #18: 15 ft
Depth alongside MLW **(mean low water)**	#30-#35: 40 ft #20, #22: 38 ft	#4 - #8: 40 ft #3: 34 ft	40 ft
Deck height above MSL	#30 - 35: +9 ft	+7 ft	#16, 17: +10 ft
(mean sea level)	#20, 22: +10 ft		#10, 18: +9 ft
Mechanical Handling Facilities	Eight container cranes (five 50-ton, one 45-ton, two 40-ton), One 112-ton gantry whirly crane	Four container cranes (one 50-ton, two 45-ton, one 40-ton) Two 50-ton rubber tired gantry cranes, One 100-ton multi-purpose whirly crane, One 40-ton container stacker,	Six container cranes (two 50-ton, four 40-ton) Six 40-ton rubber tired gantry cranes
On-Dock Rail Connection	CSX	CSX, Norfolk Southern (Florida East Coast Railway near-dock)	CSX
Highway Connections	I-95 and I-295 (State Road 9A) leading to Hecksher Drive (State Road 105)	I-95 and I-10 to U.S. 1 leading to 8th, 11th, or 21st Streets	I-95 and I-295 (State Road 9A) leading to Hecksher Drive (State Road 105)

2.1.3 GENERAL NAVIGATION FEATURES

The current project depth is 40ft between the channel entrance and river mile 20, with the exception of Blount Island Channel, which has a depth of 38 ft. Channel width is variable between each cut, as shown in Table 2-6.

Table 2-6: Navigation Channel Sections[7]

Channel Section[8]	Terminal/Use	Width (ft)	Length (nm)	Transit Speed (nm/hr)	Depth
St John's Bar Cut Range - East Section		800	2.10	10-12	42
St John's Bar Cut Range - West Section		800	1.50	10-12	40
Pilot Town Cut Range		950	1.00	10-12	40
Mayport Cut Range		1050	0.50	10-12	40
Sherman Cut Range		950-650	0.70	6-8	40
Mile Point Lower Range and Turn		650	0.50	10-12	40
Training Wall Reach		650-500	1.10	10-12	40
Short Cut Turn		600	0.40	10-12	40
White Shells Cut Range		580-1280	0.70	10-12	40
St John's Bluff Reach		1200-1100	0.60	10-12	40
Dames Point - Fulton Cutoff Range	Blount Island Marine Terminal	1580-500	2.70	6-8	40
Blount Island Channel	Blount Island Ro-Ro/ JEA Fuel Dock	300-800	1.70	6-8	38
Dames Point Turn	Dames Point Terminal	900-1200	0.40	6-8	40
Quarantine / Upper Range	Dames Point Terminal	1000-550	0.70	6-8	40
Brills Cut Range	Dames Point (Cruise)	550-450	0.80	8-10	40
Broward Point Turn	Petrochemical Docks	625-850	1.00	8-10	40
Drummond Creek Range	Navy Fuel Depot	650-400	1.50	8-10	40
Trout River Cut Range		400-500	1.00	8-10	40
Chaseville Turn	Petrochemical Docks	500-700	0.60	8-10	40
Long Branch Range	Petrochemical Docks	650-2000	0.70	6-8	40
Terminal Channel	Talleyrand Marine Terminal	575-1025	3.00	6-8	40

2.1.3.1 CHANNEL UTILIZATION ANALYSIS

The goal of channel utilization analysis is to determine the extent, frequency, and spatial location of navigation channel capacity usage. Analysis of the sailing draft distributions of vessels calling these terminals provides insight into the trades that are depth constrained. Figure 2-13 through Figure 2-16 provide illustrations on the terminals receiving vessel calls and the channel depths being used based on St John's Harbor Pilot data.

[7] Channel sections, widths, length, transit speeds, and depths as represented in HarborSym.
[8] Channel sections in bold are within the project footprint.

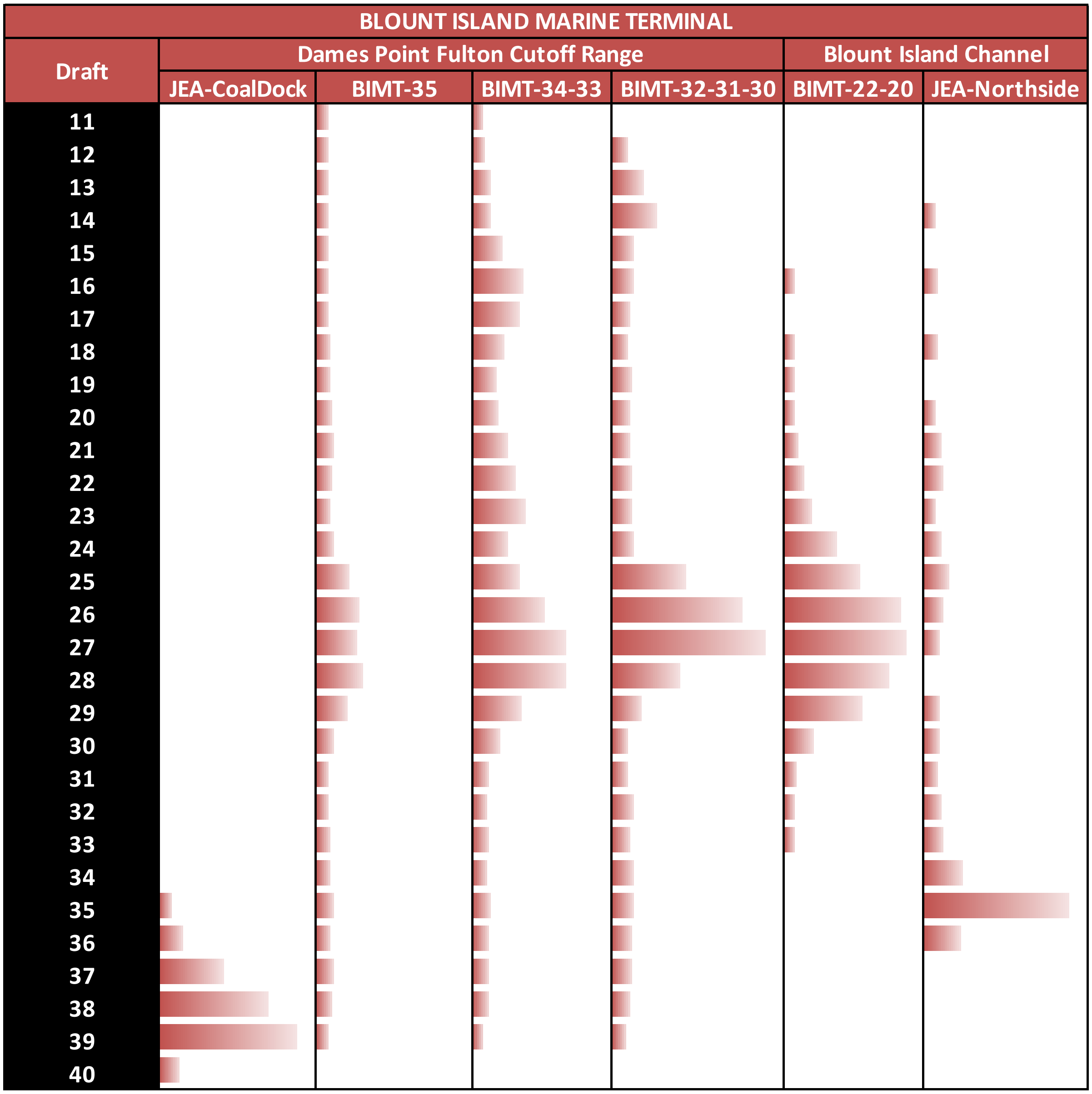


Figure 2-13: JEA and Blount Island Terminal Channel Use- Sailing Draft Distributions

Figure 2-13 provides an illustration of channel utilization by the vessels calling Blount Island and the JEA terminals. The JEA Coal Dock and the Northside Plant show signs of being depth constrained. The sailing draft distributions are clustered at the channel depth limits. Blount Island Marine Terminal receives a vast assortment of cargoes, vessel types, and classes, as evidenced by the wide range of sailing drafts.

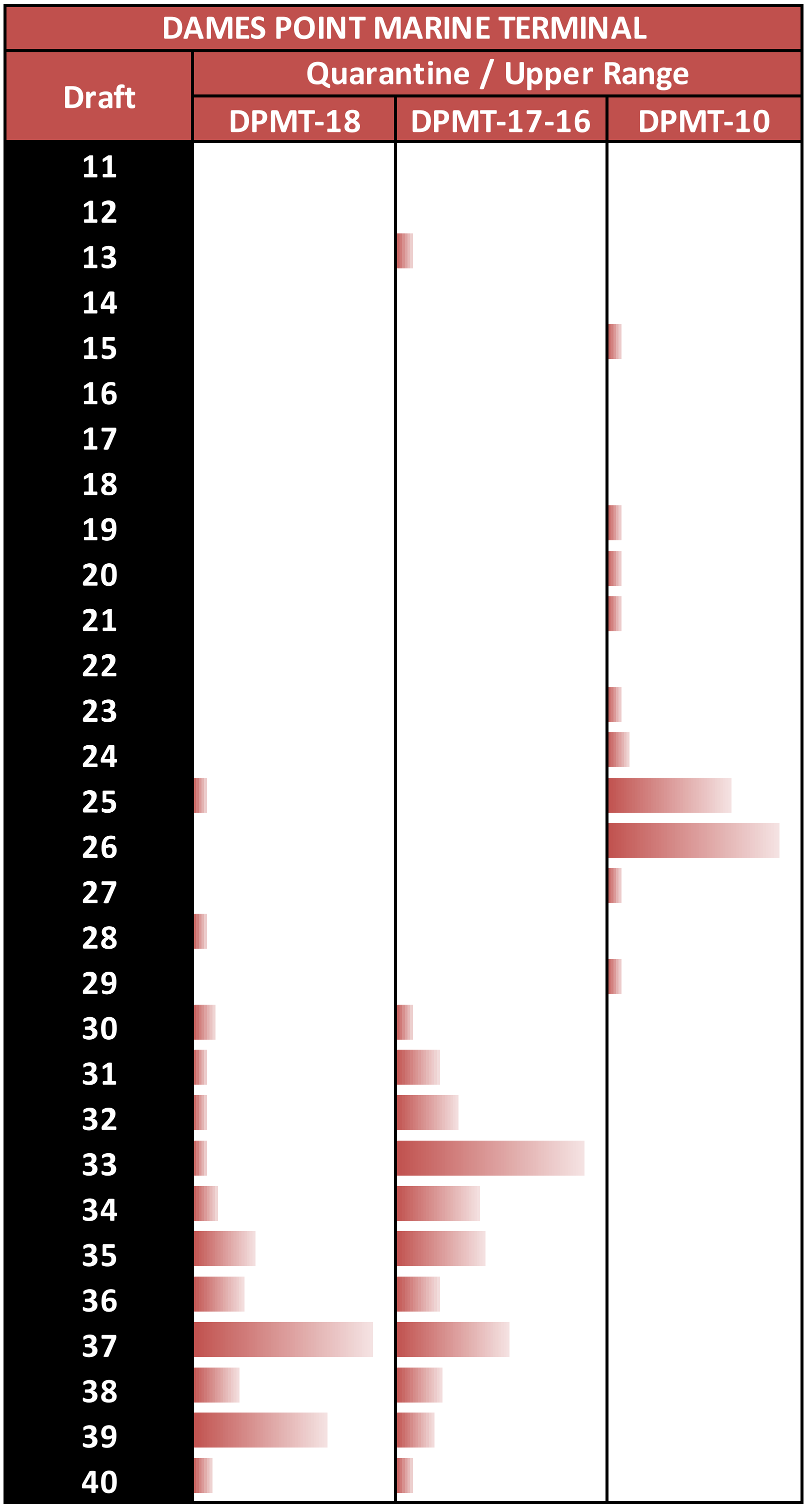


Figure 2-14: Dames Point Terminal Channel Use – Sailing Draft Distributions

Figure 2-14 illustrates the channel use for vessels calling the Dames Point Terminal. The 1st three berthing areas at Dames Point are draft constrained. Bulk vessels delivering dry-bulk freight call DPMT-18, while PX2 and PPX1 size containerships call DPMT-17-16.

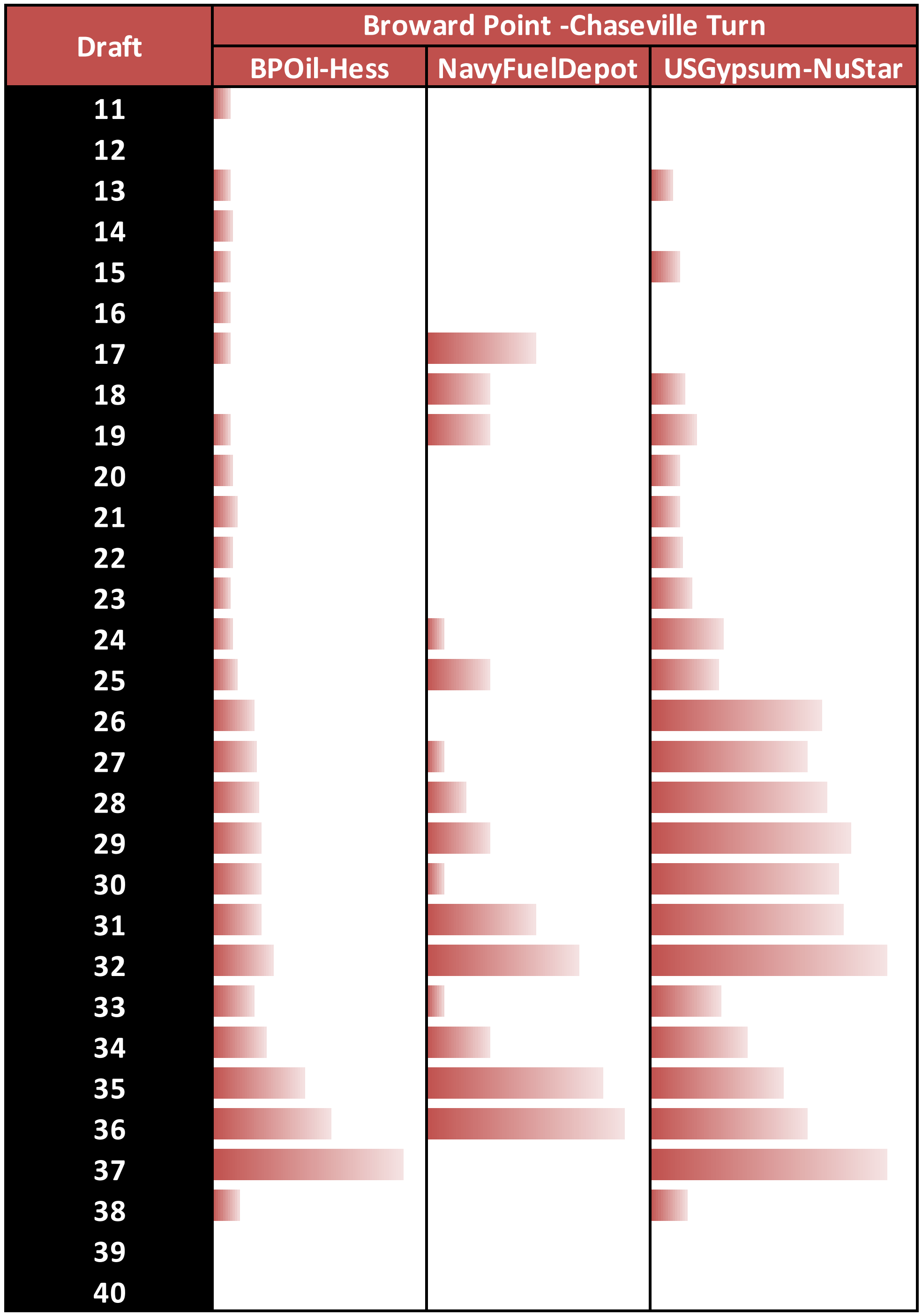


Figure 2-15: Chaseville Turn Channel Use - Sailing Draft Distributions

Figure 2-15 illustrates the channel use for vessels calling the Chaseville Turn channel area. The BP Amoco , Amerada Hess terminals are the largest recipients of liquid bulk cargoes at the Harbor. While these terminals utilize as much channel depth as practicable, these cargoes are not within the project footprint.

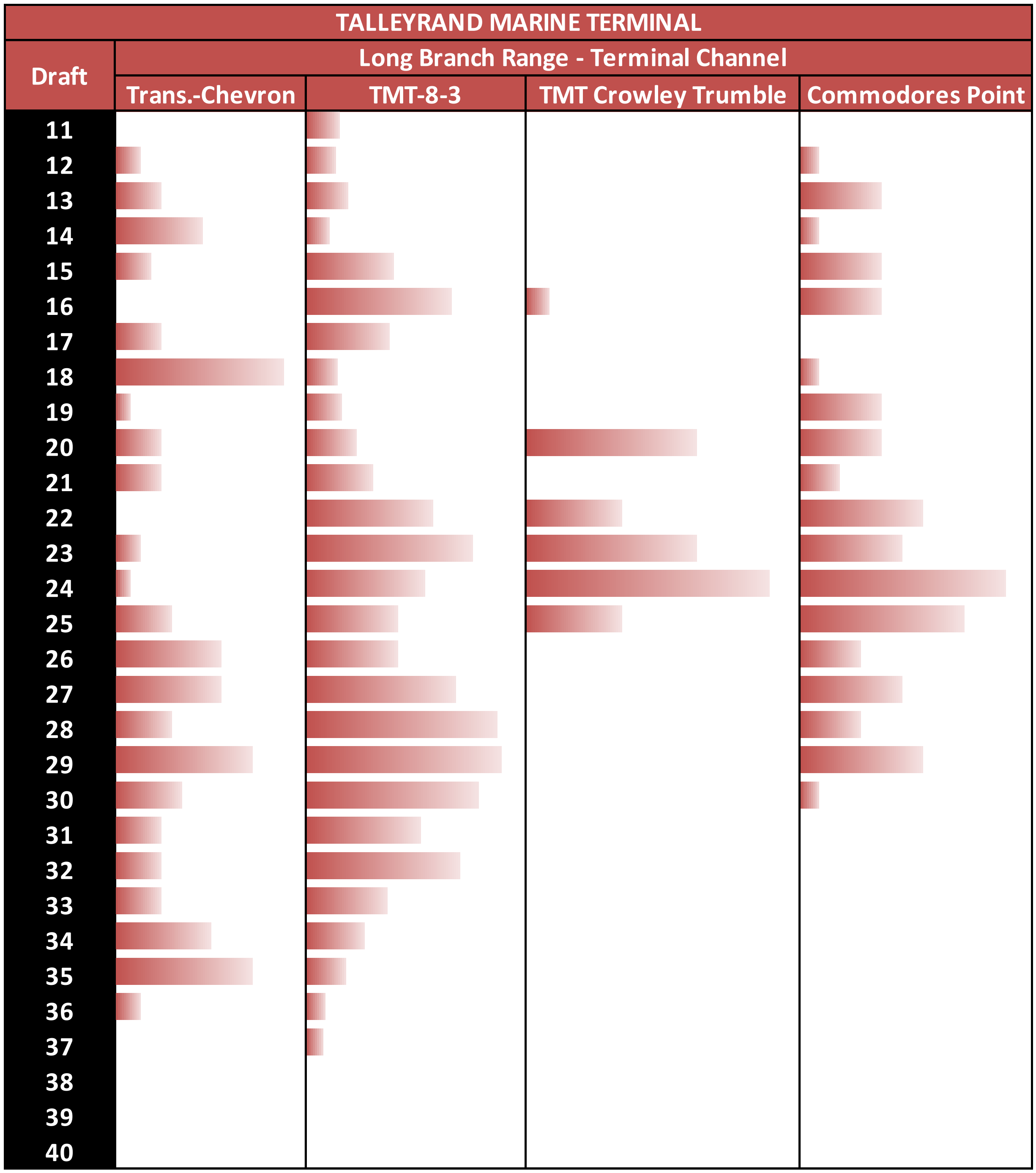


Figure 2-16: Talleyrand – Terminal Channel Sailing Draft Distributions

Figure 2-16 illustrates channel use for vessels calling Talleyrand and Terminal Channel. This section of the navigation channel has a relatively broad distribution of sailing drafts. Vessels calling these terminals include SPX and PX1 vessels, general cargo, reefer, roro and smaller bulkers and tankers.

2.2 FREIGHT COMPOSITION

A trade concept is the manner in which freight is unitized, loaded and unloaded from a vessel so that it can be traded. The two categories of trade concepts are general cargo and bulk. General cargo[9] trade concepts are further categorized as container[10], break-bulk[11], and neo-bulk[12]. Bulk cargoes[13] are simply dry bulk, and liquid bulk.

Using PIERS data, the commodities were organized into container, dry bulk, liquid bulk, and break-bulk and neo-bulk trade concepts. As Figure 2-17 illustrates, there is substantial liquid and dry bulk volume moving through the harbor. However, those cargoes are a declining share of the total port volume. However, while all other cargoes are either flat or declining, container throughput shows a steady increase, even during the recessionary period of 2008-2009.

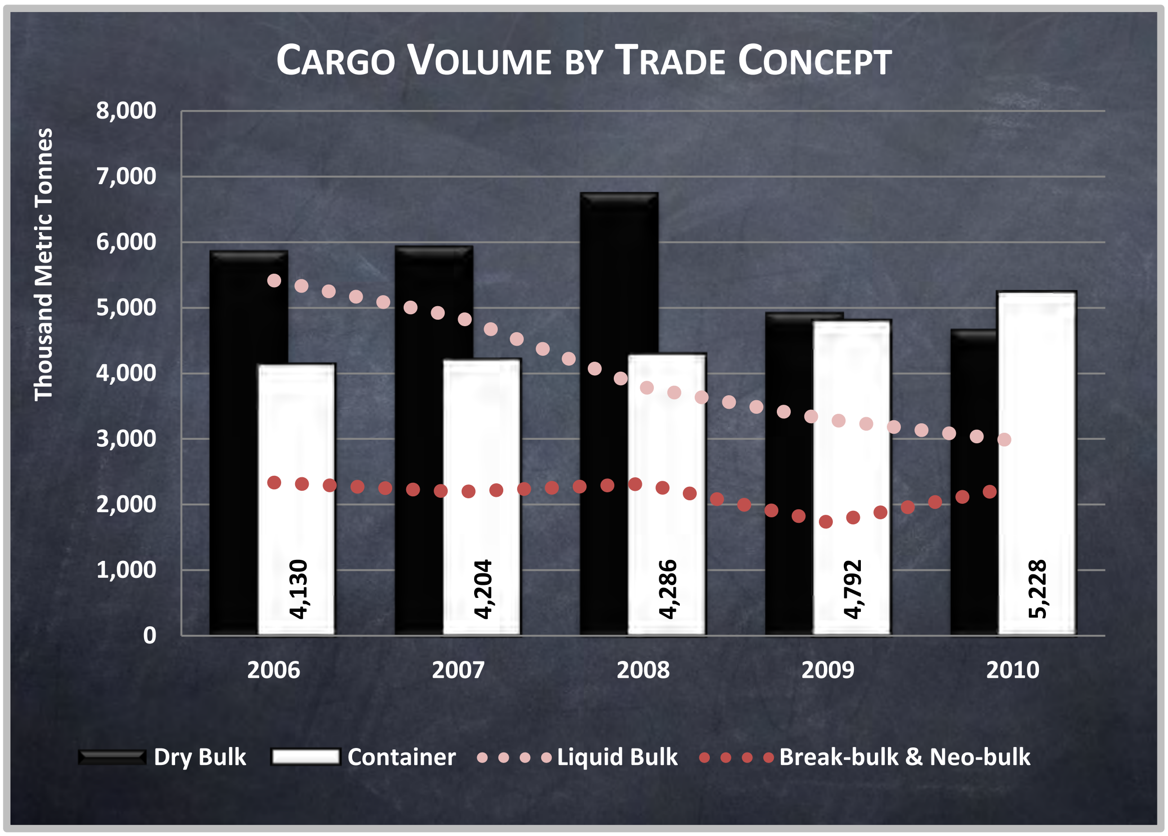


Figure 2-17: Volume in Metric Tonnes/Year by Trade Concept

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[9] **General cargo** goods that must be packaged and subdivided into individual units before being loaded or unloaded into the ship's cargo holds. Container, break-bulk, and neo-bulk are subsets of general cargo.

[10] **Container** cargo is cargo loaded into standard size steel containers that are easily transferred between different transportation modes.

[11] **Break-bulk**, the most labor intensive trade concept, consists of goods that are loaded and unloaded into the cargo hold in pallets, sacks, drums, or boxes.

[12] **Neo-bulk** cargos refer to goods that can be loaded and discharged from a vessel in countable units but transported in shiploads. (Ex. cars, lumber, scrap metal)

[13] **Bulk cargo** represents unpackaged, uncounted freight that is loaded, transported, and discharged in shiploads such as grain, coal, and petroleum products.

2.2.1 CONTAINERS

Container cargo trade concepts were aggregated into trade route groupings based on an assessment of cargo origin/destination, vessel type and class, and carrier. A trade route was deemed significant if a channel deepening could conceivably influence vessel size deployment and/or channel utilization behavior. This implies the fleet moving the cargo will have its range of operational drafts constrained due to insufficient channel depth in the future without project condition. Furthermore, the fleet servicing these routes is likely to transition to larger vessels over the period of analysis.

2.2.1.1 ORGANIZATION OF TRADE ROUTES

The purpose of trade routes in the analysis is to organize the likely network of commodity flow through the port. In this analysis, the trade route defines cargo sources and destinations, port itineraries, and the distances to be traveled in nautical miles. Trade route organization is based primarily on information obtained from Drewry's, and supplemented by PIERS data. Trade routes used in the analysis consist of East-West, North-South, regional Central American-Caribbean, and domestic Puerto Rican – Jacksonville trades. The majority of the benefits of a deepening are anticipated to come from the East-West trades due to expected growth in cargo volumes, the Panama Canal expansion, and an anticipated transition of fleet to primarily Post Panamax size vessels. The following section goes into greater detail on the trade routes.

Table 2-7: Trade Route Groupings

Route Group	FE-ECUS-PAN	FE-ECUS-SUEZ	FE-EU-ECUS-GMEX	ECSA-ECUS
Carrier	HMM	K-Line/MOL	MOL	Hamburg Sud
	APL	MOL/Evergreen	APL	Alianca
		CMA-CGM		CSAV
Services	NYX	PEX3	APX	Libra Tango-New Tango
	CNY	SVE	Liberty Bridge	
		SVS		
Voyage Details				
Frequency	Weekly	Weekly	Weekly	Weekly
RT Voyage (# days)	63-77	63-70	70-91	49
# Vessels	9-11	9-10	13	7
Avg TEU Capacity	4632-4861	5900-6000	4,800	4400
Circuitry Distance (nm)	~ 24,000	~26,000	~30,000	~13,600

2.2.1.1.1 FE-ECUS-PAN (FAR-EAST –PANAMA CANAL- US EAST COAST)

This trade represents the Far East to US East Coast end to end trade that transits the Panama Canal. Currently, the vessels using this route tend to call the MOL TraPac terminal at Dames Point, and tend to be PX2 size vessels. This traffic is anticipated to shift to PPX1 – PPX2 size vessels in the future.

2.2.1.1.2 FE-ECUS-SUEZ (*Far-East –Suez Canal- North America*)

Far-East/Southern Asia/Indian Sub-Continent to US East Coast end to end trade that transits the Suez Canal. Currently, the vessels using this route call the MOL TraPac terminal at Dames Point, and tend to be PX2 and PPX1 size vessels. This traffic is anticipated to shift to PPX2 size vessels in the future.

2.2.1.1.3 FE-EU-ECUS-GMEX (*Far East – Europe – US East Coast – US Gulf Coast – Caribbean*)

This route represents a composite of services calling Jacksonville in vessel sizes have ranged from ranging from SPX to PX2. Regions served include Europe, US East Coast, US West Coast, and US Gulf Coast.

2.2.1.1.4 ECSA-ECUS (*East Coast South America – US East Coast*)

This trade route services the North and South American Eastern seaboards. Vessels servicing this trade are in the PX2 class. It is anticipated that in the future, this trade will transition to PPX1 with or without a project.

2.2.1.1.5 OTHER (*Caribbean – Puerto Rico – US East Coast*)

Jacksonville has a niche cargo trade with Puerto Rico that encompasses roughly 61% of the overall port throughput. There are also smaller foreign flag services calling Jacksonville and servicing the US East Coast. However, it is a regional trade moving on vessels that are not constrained by the current channel depths, and is not considered significant for plan selection.

2.2.2 DRY-BULK

Dry bulk cargo moving through Jacksonville consists of the coal, limestone, and dry bulk construction materials. Coal sourced from foreign deepwater ports increased steadily between 2006 and 2008 but fell rather sharply between 2008 and 2009. Coal is received either from domestic sources by rail, or foreign sources by ocean going vessels. Coal is primarily sourced from Puerto Bolivar in Columbia. Depending on price fluctuations, the plant maintains the capability to alter fuel sources as necessary to meet electricity demand. Coal is used to generate electricity at the St Johns River Power Park.

Dry-Bulk construction materials (limestone, granite, and gypsum) are sourced primarily from Central America, Canada, and the Caribbean. Most of these materials are delivered to the Bulk facility located at Dames Point. There are limestone cargoes delivered to the JEA Northside facility from time to time.

The trade routes used to represent these cargoes are as follows:

- **COAL-COMPOSITE**: Columbia (85%) and the Caribbean (15%)
- **BULK-COMPOSITE**: Canada (45%), Caribbean (39%), and Mexico (15%)

For modeling and reporting purposes, coal and pet coke was designated as coal, and the dry bulk construction materials was called 'dry bulk'.

2.2.3 BREAK-BULK, NEO-BULK, & LIQUID BULK

Remaining cargo categories that are of less importance to the analysis consist of liquid bulk, break-bulk, and vehicular cargoes. While these trade concepts move through the port in significant quantities, their only relevance to the economic analysis is that they represent a source of harbor congestion.

2.2.4 TRADE ROUTE COMPOSITION BY TRADE REGION

Once the trade routes defined in the existing condition were associated with the countries that constitute Jacksonville's trading partners in the PIERS data and the Global Insight commodity forecast. Aggregating the forecasted volume of the trade partner into the route allows the "trade" to be grown over the period of analysis. As a result, the cargo categories have the same nomenclature as the trade routes within the HarborSym environment with the exception being the coal and dry-bulk cargoes. Table 2-8 illustrates the trade regions associated with each trade route.

Table 2-8: Distribution of Route Cargo by Region (Source: Global Insight)

Route Group	Region	%
BULK-COMPOSITE	CENTRAL AMERICA	31%
	CARIBBEAN	28%
	NORTH AMERICA	17%
	EAST COAST SOUTH AMERICA	12%
	EUROPE	9%
	OTHER	3%
COAL-COMPOSITE	EAST COAST SOUTH AMERICA	85%
	CARIBBEAN	15%
ECSA-ECUS	EAST COAST SOUTH AMERICA	100%
FE-ECUS-PAN	ASIA	100%
FE-ECUS-SUEZ	ASIA	80%
	AFRICA	11%
	MIDEAST	3%
	EUROPE	3%
	MEDITERRANEAN	1%
	OCEANIA	1%
	MIDDLE EAST	1%
FE-EU-ECUS-GMEX	CARIBBEAN	40%
	EUROPE	32%
	WEST COAST SOUTH AMERICA	18%
	CENTRAL AMERICA	9%

- Trade Route Distances as specified in HarborSym
  - FE-ECUS-PAN – 22,500 nm
  - FE-ECUS-SUEZ – 24,300 nm
  - FE-EU-ECUS-GMEX – 30,000 nm
  - ECSA-ECUS – 12,000 nm
  - COAL-COMPOSITE – 1391 nm
  - BULK-COMPOSITE – 1,400 nm

2.2.5 THE RELEVANT TRADE CONCEPTS…

The process for determining the relevant trade concepts was based on the following three propositions:

- ***Proposition-I:*** *The economic modeling effort was focused on estimating the transportation costs of moving the cargo that has the greatest influence on plan formulation.*
- ***Proposition-II:*** *-All primary benefiting cargoes are restricted to the 1st 13 river miles of the channel.*
- ***Proposition-III****-Exclude trade concepts and cargo traffic that move on vessels that aren't depth constrained from consideration as a primary benefit.*

Proposition-I: The economic analysis should be focused on estimating those benefits that have the greatest influence on formulation. Potential benefits are categorized as primary or incidental. Primary benefits are those that are achievable because a certain action was taken. For example, the reduced cost of commodity movement because a vessel can sail deeper because the channel was deepened is a primary benefit. Incidental benefits are benefits that are only achievable after the primary benefit has been realized. For example, if deepening a channel results in fewer port calls because more freight can be moved per call, then ships that don't benefit from the deepening, will still benefit from the reduced harbor congestion. The implication is that primary benefits have the greatest influence on formulation.

It is anticipated that the container traffic will have the largest influence on formulation because of the trend toward larger vessels and the nature of the container business. Channel constraints are most likely to impose the greatest costs on the movement of this trade concept. Containers are also the most complex trade concept to model. The complexity of container analysis coupled with time and schedule limitations the PDT decided to prioritize the analysis on the container effort.

A significant portion of the dry bulk moving through Jacksonville is coal receipts to the St Johns River Coal Terminal, and dry bulk aggregates moving through the Dames Point Marine Terminal. It is conceivable that a deeper channel could influence vessel size deployments and capacity utilization for the traffic moving at these terminals.

Proposition-II: -All primary benefiting cargoes are restricted to the 1st 13 river miles of the channel. As stated previously in section 0, channel modification alternatives have been constrained to the 1st 13 river miles of the federal project to limit costs and environmental impacts. The marine terminals within that footprint are The St Johns River Coal Terminal, Blount Island, and the Dames Point marine terminals. This effectively excludes liquid bulk cargoes from consideration as a primary benefit category, because the 1st major liquid bulk terminals are located in the Broward Point Turn vicinity of the channel, ~ river mile 15. Also, as shown by figure, liquid bulk transits have fallen by 46% between 2006 and 2010.

Proposition-III-Exclude trade concepts and cargo traffic that move on vessels that aren't depth constrained from consideration as a primary benefit. This excludes general cargo, RoRo, and cruise traffic, none of which are constrained by the existing channel.

As a result of the aforementioned propositions, the economic analysis was focused mostly on containers and to a lesser extent, dry bulk trade conceptualizations. In the following sections, these two trades are explored in further detail.

2.2.6 FLEET COMPOSITION

Ultimately, it is the fleet of vessels moving the cargo that connect all patterns of maritime trade circulation. Within the maritime transport industry the entire range of coordinated human activity is focused on delivering the cargo using the vessel. Consequently, it is the operating cost of the vessel that captures the resource cost of the commodity movement. Therein lays the relevance of the fleet to the economic analysis. This section is used to describe the predominant usage, dimensions, volumetric and deadweight tonnage capacities of the vessels currently calling, or anticipated to call in a future condition. It should be noted that the vessel sizes depicted in this section are sizes represented in HarborSym.

2.2.6.1 FLEET DIMENSIONS & CAPACITIES

Data on the fleet characteristics and capacities was compiled from Lloyds –Seaweb, Waterborne Commerce Statistics Center, and IWR.

- **Length Overall (LOA)** – Length if vessel from bow to stern in ft
- **Beam** – Width of vessel from starboard to port in ft
- **Draught** – Maximum depth in feet below the waterline the vessel when the vessel deadweight is fully utilized
- **Immersion Factor (TPI)** – The rate the vessel sinks below the waterline per additional metric tonne of cargo in metric tonnes per inch.
- **Deadweight Tonnes (DWT)** – Total weight carried on the vessel in metric tonnes.

DWT = cargo + fuel + fresh water + ballast water + provisions + crew

2.2.6.2 VESSEL CLASSIFICATION AND ATTRIBUTES

The vessel categories currently calling Jacksonville Harbor include containerships, bulkers, tankers, general cargo vessels, barges, and cruise ships. The vessels were classified based on different criteria. SPX, bulkers, and tankers were classified based on capacity, PX vessels by draught in feet, and PPX ships by beam in ft. Barges were classified by length. However, of primary concern here is the containership and bulker fleets. Table 2-9 provides detail on the existing condition vessel calls by class.

2.2.6.3 VESSEL OPERATING COSTS

VOCs were developed from the IWR EGM 11-05 Vessel Operating Cost tables. However, these operating costs contained only the service speed sea cost, and the dockside static port costs. The VOC typically have the following criteria:

- At Sea
    - Service Speed
    - Economic Speed
    - Half-Power
    - Base Idle
- In-Port
    - Within Harbor Channel Transit
    - Maneuvering
    - Base Idle
    - Dockside\ Static Condition

To account for slow steaming practices, the ratio of economic speed: service speed and half power: service speed were taken from the 2009 – 2010 VOCs and applied to the EGM 11-05 operating cost.

Vessels that don't benefit from the deepening use the in harbor channel transit operating cost for the cost at sea.

Table 2-9: Existing Condition Vessel Calls

Vessel Class Name	2006	2007	2008	2009	2010
SPX1	157	166	151	114	80
SPX2	228	197	158	159	150
PX1	51	55	58	91	94
PX2		1	24	123	168
PPX1					29
REEFER	27	22	17	14	16
RORO	197	221	200	196	198
VEHICLES CARRIER	475	521	581	429	493
GC	251	231	225	212	240
BARGE-GC-BULK	521	552	532	471	504
BARGE-TANK	177	341	375	319	319
10-20k DWT Bulker	8	7		4	
20-30k DWT Bulker	21	10	2	5	12
30-40k DWT Bulker	41	33	16	5	10
40-50k DWT Bulker	50	37	47	20	15
50-60k DWT Bulker	28	33	29	8	5
60-70k DWT Bulker	26	13	19	34	39
70-80k DWT Bulker	11	32	35	40	30
10-20k DWT Tanker	9	10	12	13	10
20-30k DWT Tanker	5	3	2	1	3
30-40k DWT Tanker	21	17	15	18	12
40-50k DWT Tanker	154	143	124	93	75
50-60k DWT Tanker	9	9	18	20	28
60-70k DWT Tanker	8	22	21	23	13
70-80k DWT Tanker	9	5	20	18	10
Total # Calls	**2484**	**2681**	**2681**	**2430**	**2553**

2.2.6.4 CONTAINERSHIPS

Table 2-10 provides detail on the containership fleet. To date PPX1 size vessels are the largest ships to call in the existing conditions. The current navigation channel configuration will not support a PPX2. The PX2 is the predominant workhorse of the fleet moving containers on the East-West routes through Jacksonville. Most of the PX2 and PPX1 traffic goes to Dames Point. The majority of the SPX size vessels call Talleyrand.

Table 2-10: Fully Cellular Containership Fleet[14]

Vessel Class Name	DWT	TEU Rating	Beam	LOA	Draft	Immersion Rate	Underkeel Clearance
SPX1	23,200	1,500	79.26	523.32	33.74	74.41	2.7
SPX2	40,300	2,400	95.77	692.35	39.05	121.38	2.7
PX1	46,400	3,600	104.88	782.83	40.40	148.26	2.7
PX2	60,000	4,200	106.43	869.79	44.50	177.92	3.0
PPX1	70,500	6,100	131.00	950.53	45.72	204.52	3.3
PPX2	103,000	8,600	145.66	1,132.43	48.96	286.63	3.6

2.2.6.5 BULKERS

Table 2-11 provides detail on the fleet of bulker vessels. Bulkers are used primarily for import coal to the St Johns River Coal Terminal or aggregate, and limestone to the Dames Point Marine Terminal.

Table 2-11: Bulker Fleet[15]

Vessel Class Name	DWT	Beam	LOA	Draft	Immersion Rate	Underkeel Clearance
10-20k DWT Bulker	15,000	78.84	509.95	29.56	69.44	2.7
20-30k DWT Bulker	25,000	84.69	549.92	32.29	86.12	2.7
30-40k DWT Bulker	40,000	91.75	597.66	35.54	107.37	2.7
40-50k DWT Bulker	50,000	98.58	643.10	38.63	129.02	2.7
50-60k DWT Bulker	60,000	103.85	677.67	40.98	146.65	3.0
60-70k DWT Bulker	70,000	106.00	740.00	43.71	160.00	3.3
70-80k DWT Bulker	80,000	113.89	742.19	45.34	182.72	3.6
80-90k DWT Bulker	90,000	115.00	751.00	47.15	200.00	3.6
90-100k DWT Bulker	100,000	123.29	800.55	49.27	219.87	3.6

2.2.6.6 GENERAL CARGO

Table 2-12 displays the characteristics for the fleet of general cargo, vehicle carriers, roro, and reefer carriers that move break-bulk and neo-bulk cargoes through the port. Most of these vessels call Blount Island or Talleyrand. None of these vessels are currently draft constrained.

Table 2-12: General Cargo Fleet

Vessel Class Name	DWT	Beam	LOA	Draft	Immersion Rate	Underkeel Clearance
REEFER	12,500	71.08	481.69	30.58	60.67	2.7
RORO	28,000	83.43	595.22	26.40	78.67	2.7
VEHICLES CARRIER	19,253	103.10	628.42	30.99	76.00	2.7
GC	30,000	71.59	451.70	27.40	76.65	2.7
BARGE-GC-BULK	45,000	75.83	606.17	32.15	63.18	2.7

[14] PPX2 vessels have not called in the existing condition.
[15] 80-90k and 90-100k DWT Bulkers have not called in the existing condition.

2.2.6.1 <u>TANKERS</u>

Table 2-13 provides detail on the fleet of tankers used in the importation of petroleum products. Most of these vessels discharge their cargoes at the BP-Amoco, Amerada Hess, NuStar, Chevron, and TransMontaigne petrochemical terminals. None of the terminals are within the project footprint.

Table 2-13: Liquid Bulk Fleet

Vessel Class Name	DWT	Beam	LOA	Draft	Immersion Rate	Underkeel Clearance
BARGE-TANK	45,000	66.24	365.65	23.97	53.56	2.7
10-20k DWT Tanker	20,000	80.19	518.62	32.34	73.81	2.7
20-30k DWT Tanker	25,000	83.94	537.80	33.42	82.54	2.7
30-40k DWT Tanker	35,000	91.25	575.17	35.55	99.70	2.7
40-50k DWT Tanker	50,000	101.75	628.80	38.63	124.65	2.7
50-60k DWT Tanker	60,000	108.44	662.93	40.62	140.75	3.0
60-70k DWT Tanker	70,000	114.88	695.76	42.55	156.44	3.0
70-80k DWT Tanker	80,000	121.07	727.29	44.42	171.71	3.3
80-90k DWT Tanker	90,000	127.01	757.52	46.23	186.56	3.6
90-100k DWT Tanker	100,000	125.00	800.00	49.21	215.00	3.6

Figure 2-18 provides an illustration of the sailing draft distributions by vessel type. The bulker and PPX distributions are clustered at the bottom of the distribution, indicative of a draft constrained fleet. The PX fleet is (PX2) vessels in particular would be the next class of vessels that could conceivably utilize more depth.

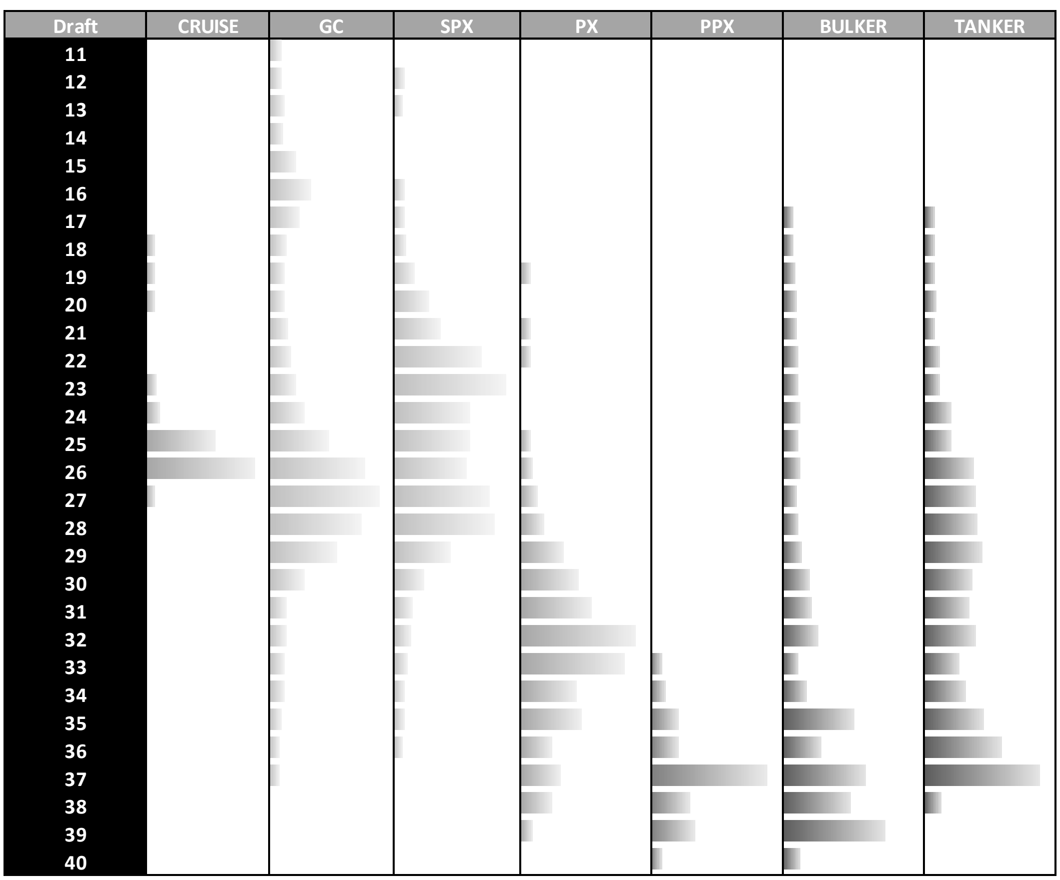

Figure 2-18: Sailing Draft Distribution by Vessel Type

2.3 THE RELATIONSHIP BETWEEN THE FACILITIES, THE FLEET, & THE FREIGHT

This section of the appendix describes the nature of the relationship between freight movements and the harbor infrastructure. This is done to identify the relevant freight movements and analyze how those freight movements utilize the Harbor infrastructure. The goal is to understand how a change in harbor infrastructure will affect freight movement characteristics. To accomplish this, an inventory of the variables connecting freight movement and harbor facilities must be established. The steps undertaken were as follows:

1) Analyze the characteristics of the fleet moving each cargo type
2) Determine the extent to which the fleet moving each trade concept utilizes the port infrastructure.
3) Isolate the inventory of variables that connect the GNFs and LSFs to the freight movements.

2.3.1 THE VOLUME, COMPOSITION, & FLOW OF CONTAINER CARGO

- **Volume**

The amount of volume moved per annum provides evidence of the extent of the demand for freight transport. Greater volume at a port means more revenue for the carriers moving that volume. Thus, not only does more volume incentivize carriers to make port calls, it also incentivizes them to do so with a fleet that can deliver the cargo at a lower operating cost per slot.

Figure 2-19 provides an illustration of the three major container trades moving through Jacksonville Harbor. The percentages of total container throughput are as follows:

- CAR-PR-JAX ~ 63%
- East-West ~28%
- North-South ~9%

Growth in the East-West trade begins to grow rapidly in 2008. The North-South trade declines between 2006 and 2008, stabilizes in 2009, and is back to growth in 2010.

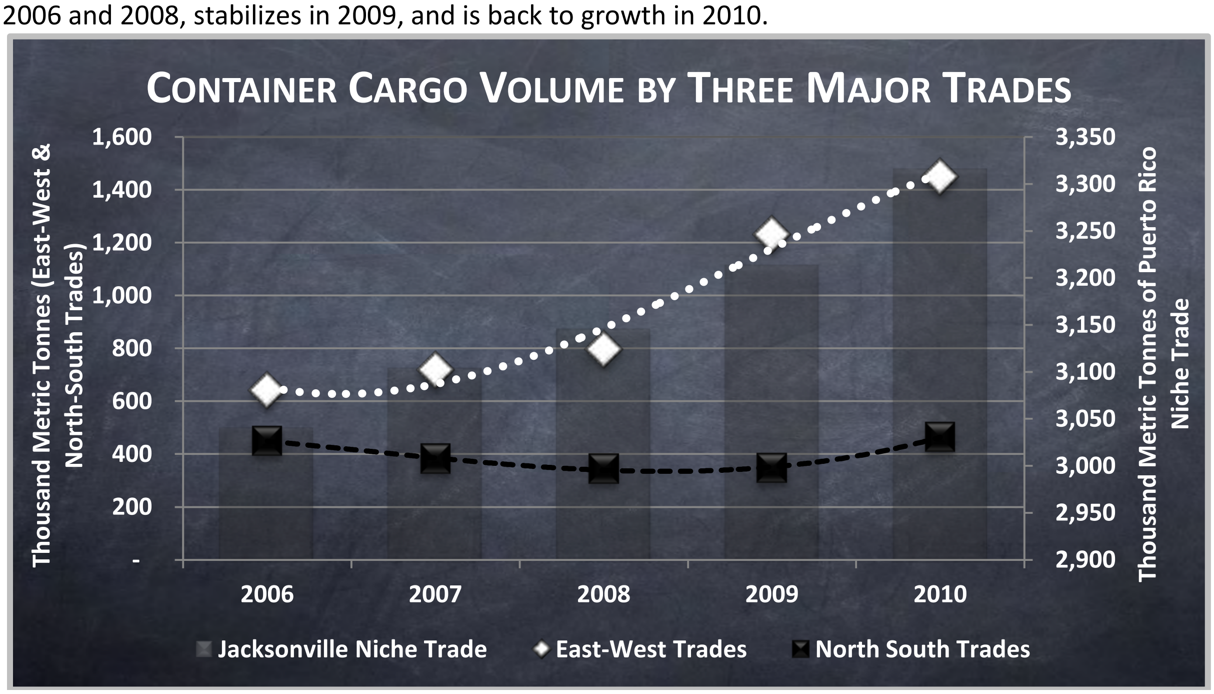

Figure 2-19: Container Cargo Volume by Major Trade

Figure 2-20 provides more detailed resolution on container volume at Jacksonville during this time frame. The introduction new East-West services in late 2008 begin to alter the nature of the cargo volume with respect to containers at Jacksonville. Completion of the MOLTraPac terminal in 2009 further accelerates the volume of Asian cargo moving through Jacksonville.

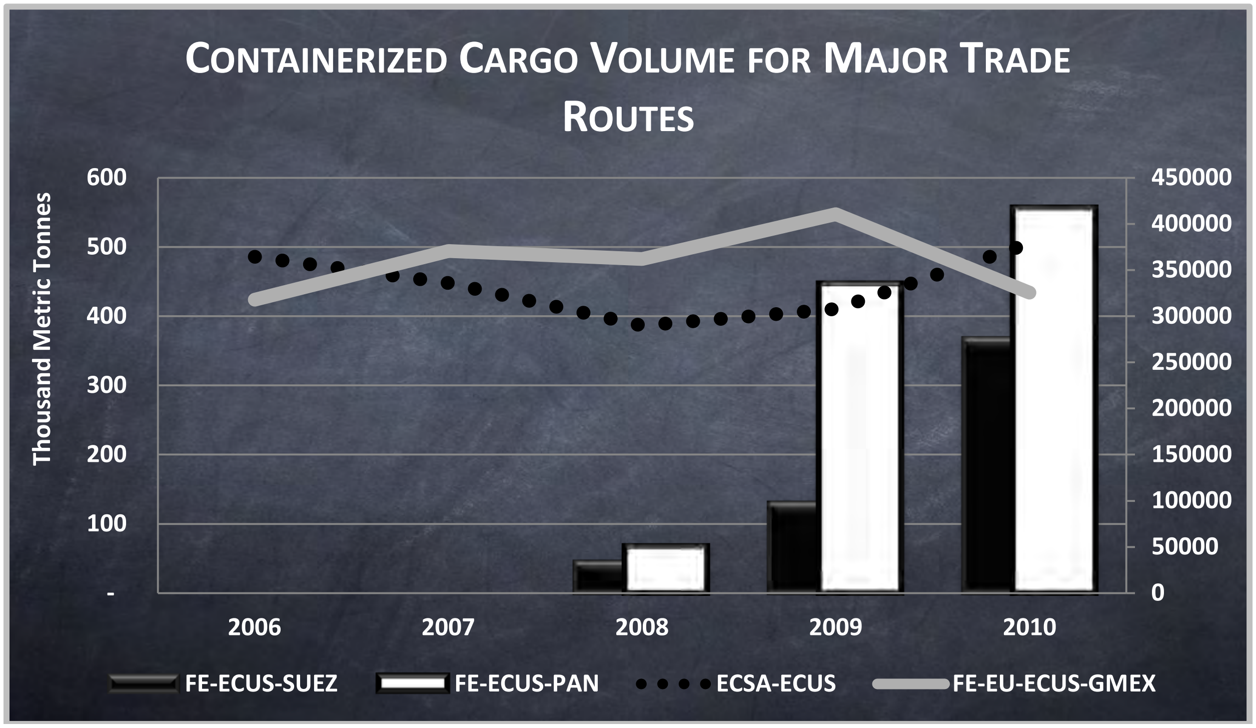

Figure 2-20: Volume by Container Cargo Type in Metric Tonnes

Composition

The composition of the commodities moving on the trade can provide insight into vessel loading /deployment behavior in the future with project condition. If the trade moves lighter cargo the vessel is more likely to reach its volumetric cargo capacity. Conversely, a heavier trade will cause the vessel to reach its deadweight capacity. Both conditions impose constraints on the amount of transportation cost savings that can be generated by a deepening alternative.

Table 2-14: Composition of Container Cargo Lading Metric

Commodity	%
FOODSTUFFS	32%
CHEMICALS	15%
MISCELLANEOUS	14%
FOREST PRODUCTS	11%
VEHICLES/BOATS/AIRCRAFT	4%
MACHINERY & PARTS	3%
HARDWARE	3%
MINERALS	3%
ELECTRIC GOODS	3%
INSTRUMENTS/PHOTO GOODS	2%
TIRES/RUBBER	2%
METALS	2%
TEXTILES	2%
FURNITURE/TOYS/SPORTING	2%
ORES	1%
PLASTIC FILM/SHEETS/FOAM	1%
FOOTWEAR/GLOVES/BAGS	0%
MISC JEWELRY/ARTS/CRAFTS	0%
Total	**100%**

JACKSONVILLE HARBOR EXPORTED & IMPORTED CONTAINERIZED CARGO COMPOSITION						
Commodity	Cargo Lading Weight Metric Tonnes /TEU	CAR-PR-JAX	ECSA-ECUS	FE-ECUS-PAN	FE-ECUS-SUEZ	FE-EU-ECUS-GMEX
ORES	13.68	0.4%	0.1%	3.1%	16.6%	4.8%
MINERALS	9.69	1.4%	5.3%	1.9%	2.5%	5.6%
FOODSTUFFS	9.24	37.0%	13.6%	18.9%	12.3%	26.1%
CHEMICALS	9.02	16.0%	20.9%	12.8%	10.2%	13.5%
METALS	8.80	1.8%	1.5%	1.5%	7.1%	2.5%
FOREST PRODUCTS	8.17	6.8%	15.0%	29.6%	13.6%	22.0%
PLASTIC FILM/SHEETS/FOAM	6.88	0.4%	0.7%	0.8%	2.0%	0.7%
ELECTRIC GOODS	6.12	2.9%	2.6%	1.2%	1.1%	1.3%
MISCELLANEOUS	5.96	17.8%	5.0%	4.4%	4.7%	4.1%
TEXTILES	5.85	1.8%	0.7%	2.1%	2.4%	1.5%
MACHINERY & PARTS	5.44	2.9%	6.3%	1.6%	2.5%	3.4%
TIRES/RUBBER	5.27	2.2%	2.9%	3.3%	7.1%	2.0%
MISC JEWELRY/ARTS/CRAFTS	5.08	0.2%	0.0%	1.8%	1.6%	0.1%
INSTRUMENTS/PHOTO GOODS	5.00	3.0%	2.1%	1.8%	0.8%	1.3%
HARDWARE	4.96	2.5%	1.1%	2.6%	3.8%	5.2%
VEHICLES/BOATS/AIRCRAFT	4.62	1.3%	21.4%	1.5%	1.1%	4.6%
FURNITURE/TOYS/SPORTING	4.06	1.4%	0.7%	9.0%	8.2%	1.3%
FOOTWEAR/GLOVES/BAGS	3.65	0.5%	0.1%	2.1%	2.3%	0.1%
Avg TEU Weight Per Trade Route		6.71	7.74	7.13	8.09	8.63

Figure 2-21: TEU Weight & Commodity Composition by Cargo Type

Table 2-14 provides greater detail on the composition of containerized commodities moving through Jacksonville Harbor between 2006 and 2010. The top five commodities (foodstuffs, chemicals, consumer goods, forest products, & vehicles) make up over 75% of the commodity tonnage.

Figure 2-21 illustrates the distribution of commodities on each trade as well as the cargo weight in terms of the number of metric tonnes of cargo per TEU. Ores, minerals, foodstuffs, and forest products are on the heavy side of the distribution (at the top), while footwear is on the light side of the distribution (at the bottom). Moving from the top of the list to the bottom is associated with an increase in the cargo stowage factor, or the amount of space occupied per metric tonne of cargo. The lower the stowage factor, the more suitable a commodity is for bulker transport.

Table 2-15: Container Volume % Imports-vs - Exports		
Tonnes		
Commodity Name	E	I
FEEDER-RORO-GC	83%	17%
ECSA-ECUS	73%	27%
FE-ECUS-PAN	66%	34%
FE-ECUS-SUEZ	56%	44%
FE-EU-ECUS-GMEX	72%	28%
TEU		
Commodity Name	E	I
FEEDER-RORO-GC	82%	18%
ECSA-ECUS	81%	19%
FE-ECUS-PAN	52%	48%
FE-ECUS-SUEZ	40%	60%
FE-EU-ECUS-GMEX	77%	23%

Heavier trades tend to have less of their commodity composition distributed toward the bottom. In terms of trade weight, the FE-EU-ECUS-GMEX is the heaviest, while the FE-ECUS-PAN is the lightest. However, these distributions represent a weighted average of imports and exports. In the next section we add another dimension to the analysis.

The Cargo Composition & Volume Vector

In addition to the commodity composition and volume on a trade route, the direction of cargo movement on the trade route must also be considered. Differences in import and export commodity composition and volume may make the difference in whether a particular trade will use more depth on arrival, or on departure.

Table 2-15 provides information on the distribution of imports vs. exports by trade route. For each route, exports exceed import cargo tonnages. Only on the Suez route does the distribution of export TEUS exceed the imports.

Figure 2-22 provides detail on the distribution of commodity composition per trade by imports and exports. The ECSA-ECUS, FE-ECUS-PAN, and FE-ECUS show significant differences in trade weight between imports and exports. The ECSA-ECUS is lighter outbound than inbound, while the Far East-Panama and Suez routes are the opposite.

JACKSONVILLE HARBOR EXPORTED CONTAINERIZED CARGO COMPOSITION

Commodity	Cargo Lading Weight Metric Tonnes /TEU	CAR-PR-JAX	ECSA-ECUS	FE-ECUS-PAN	FE-ECUS-SUEZ	FE-EU-ECUS-GMEX
ORES	13.68	0.0%	0.2%	5.3%	33.8%	5.9%
MINERALS	9.69	1.5%	3.1%	1.2%	0.3%	5.5%
FOODSTUFFS	9.24	40.1%	5.3%	18.1%	3.9%	26.1%
CHEMICALS	9.02	13.3%	22.4%	15.9%	15.6%	15.5%
METALS	8.80	1.6%	1.3%	0.9%	11.4%	2.0%
FOREST PRODUCTS	8.17	6.9%	14.8%	47.3%	21.6%	21.2%
PLASTIC FILM/SHEETS/FOAM	6.88	0.3%	0.8%	1.3%	3.8%	0.6%
ELECTRIC GOODS	6.12	2.3%	3.4%	1.2%	0.7%	1.1%
MISCELLANEOUS	5.96	20.4%	6.2%	1.9%	1.2%	5.2%
TEXTILES	5.85	1.7%	0.8%	1.7%	2.2%	1.6%
MACHINERY & PARTS	5.44	2.8%	7.6%	1.5%	2.7%	3.7%
TIRES/RUBBER	5.27	1.6%	1.4%	0.9%	0.4%	0.8%
MISC JEWELRY/ARTS/CRAFTS	5.08	0.2%	0.0%	0.1%	0.0%	0.1%
INSTRUMENTS/PHOTO GOODS	5.00	1.7%	2.9%	0.3%	0.2%	1.8%
HARDWARE	4.96	2.1%	0.9%	0.5%	0.7%	2.2%
VEHICLES/BOATS/AIRCRAFT	4.62	1.5%	28.6%	1.4%	1.2%	5.7%
FURNITURE/TOYS/SPORTING	4.06	1.6%	0.3%	0.4%	0.1%	0.8%
FOOTWEAR/GLOVES/BAGS	3.65	0.4%	0.0%	0.1%	0.2%	0.1%
Avg TEU Weight Per Trade Route		6.81	6.76	10.06	11.29	8.20

JACKSONVILLE HARBOR IMPORTED CONTAINERIZED CARGO COMPOSITION

Commodity	Cargo Lading Weight Metric Tonnes /TEU	CAR-PR-JAX	ECSA-ECUS	FE-ECUS-PAN	FE-ECUS-SUEZ	FE-EU-ECUS-GMEX
ORES	13.68	1.8%	0.1%	0.0%	0.0%	2.8%
MINERALS	9.69	0.7%	11.0%	3.0%	4.6%	5.7%
FOODSTUFFS	9.24	23.6%	35.2%	20.0%	20.4%	26.2%
CHEMICALS	9.02	27.3%	17.0%	8.5%	5.1%	10.1%
METALS	8.80	2.2%	1.9%	2.3%	3.0%	3.5%
FOREST PRODUCTS	8.17	6.7%	15.5%	5.2%	6.0%	23.4%
PLASTIC FILM/SHEETS/FOAM	6.88	1.0%	0.4%	0.1%	0.4%	0.9%
ELECTRIC GOODS	6.12	5.3%	0.5%	1.1%	1.4%	1.5%
MISCELLANEOUS	5.96	7.0%	1.9%	7.9%	8.0%	2.1%
TEXTILES	5.85	2.2%	0.5%	2.6%	2.7%	1.2%
MACHINERY & PARTS	5.44	2.9%	2.9%	1.9%	2.3%	2.9%
TIRES/RUBBER	5.27	4.5%	6.8%	6.7%	13.6%	4.0%
MISC JEWELRY/ARTS/CRAFTS	5.08	0.1%	0.0%	4.1%	3.2%	0.3%
INSTRUMENTS/PHOTO GOODS	5.00	8.7%	0.0%	3.9%	1.4%	0.3%
HARDWARE	4.96	4.0%	1.6%	5.6%	6.7%	10.2%
VEHICLES/BOATS/AIRCRAFT	4.62	0.8%	2.6%	1.6%	1.0%	2.6%
FURNITURE/TOYS/SPORTING	4.06	0.3%	1.6%	20.8%	15.9%	2.1%
FOOTWEAR/GLOVES/BAGS	3.65	0.8%	0.4%	4.8%	4.4%	0.2%
Avg TEU Weight Per Trade Route		6.30	12.51	5.08	6.36	9.50

Figure 2-22: Import vs Export Commodity Composition by Trade Route

2.3.2 CONTAINER FREIGHT MOVEMENTS

This section is used to describe the physical and operational characteristics of the fleet calling Jacksonville Harbor. The goal is to develop an understanding of the interactivity between the fleet and the harbor infrastructure. This is accomplished in two stages. 1st we must understand how the physical characteristics of the fleet are utilized to transform annual cargo volume into a number of port calls distributed over the course of a year. Then we determine how those port calls interact with the harbor infrastructure. Table 2-16 provides data on the fleet bearing containerized cargo in the existing condition.

Table 2-16: Characteristics of the Vessels Moving Container Cargo

Vessel Class Name	DWT	TEU Rating	Beam	LOA	Draught	Immersion Rate
SPX1	23,200	1,500	79.26	523.32	33.74	74.41
SPX2	40,300	2,400	95.77	692.35	39.05	121.38
PX1	46,400	3,600	104.88	782.83	40.40	148.26
PX2	60,000	4,200	106.43	869.79	44.50	177.92
PPX1	70,500	6,100	131.00	950.53	45.72	204.52

2.3.2.1 FROM CARGO VOLUME TO PORT CALLS

This section describes the process used to develop the # of vessel calls in the existing condition. The process described here is similar to the process used in modeling the future with and future without project condition.

Annual Cargo Volume

Table 2-17 provides detail on the container cargo volume in tonnes and TEUS[16].

Table 2-17: Volume in Metric Tonnes and TEUS

	VOLUME IN TEUS				
Commodity Name	**2006**	**2007**	**2008**	**2009**	**2010**
FE-ECUS-PAN	-	-	9,474	49,359	54,412
FE-ECUS-SUEZ	-	-	4,304	11,132	33,257
FE-EU-ECUS-GMEX	48,555	57,342	53,648	53,271	48,813
ECSA-ECUS	59,429	60,703	55,864	52,883	62,163
CAR-PR-JAX	457,706	464,816	467,558	477,444	497,310
TOTAL TEUS	565,690	582,861	590,849	644,088	695,956
	VOLUME IN METRIC TONNES				
Commodity Name	**2006**	**2007**	**2008**	**2009**	**2010**
FE-ECUS-PAN	-	-	50,427	334,432	416,206
FE-ECUS-SUEZ	-	-	32,705	96,595	273,826
FE-EU-ECUS-GMEX	440,206	494,355	482,640	529,011	433,523
ECSA-ECUS	459,117	447,715	386,300	410,232	504,966
CAR-PR-JAX	3,102,191	3,108,468	3,091,746	3,203,270	3,323,838
TOTAL TONNES	**4,001,514**	**4,050,538**	**4,043,819**	**4,573,539**	**4,952,359**

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⌗ Distribution of Cargo Volume by Vessel Class:

Table 2-18 provides detail on the proportion of annual cargo volume moving on each route allocated to each vessel class. The tables show an increased proportion of overall freight being delivered on larger vessels.

Table 2-18: Proportion of Route Cargo

Commodity Name	Vessel Class Name	2006	2007	2008	2009	2010
FE-ECUS-PAN	PX1			0.5%	5.1%	6.2%
	PX2			99.5%	94.9%	93.8%
FE-ECUS-SUEZ	PX1			0.0%	10.0%	2.5%
	PX2			100%	90.0%	49.5%
	PPX1			0.0%	0.0%	48.0%
FE-EU-ECUS-GMEX	SPX1	55.7%	45.3%	52.5%	36.3%	29.2%
	SPX2	44.2%	54.7%	40.6%	13.6%	31.6%
	PX1	0.1%	0.0%	6.9%	31.1%	27.5%
	PX2	0.0%	0.0%	0.0%	19.0%	11.7%
ECSA-ECUS	SPX1	5.3%	12.4%	8.6%	3.4%	2.0%
	SPX2	1.5%	0.0%	0.0%	12.4%	10.7%
	PX1	93.2%	87.6%	91.4%	83.0%	78.9%
	PX2	0.0%	0.0%	0.0%	1.2%	8.5%

⌗ Parcel Size,[17] # Port Calls, and Sailing Draft:

Next we determine the average cargo parcel size the average parcel size moving on and off of the vessel during each vessel call. Table 2-19 provides greater detail. Cargo parcel sizes represent the weekly demand for freight transportation. There is broad variability in parcel sizes for containerized cargo. Cargo parcel sizes were determined for each route-class based on the historic average number of TEUS imported to and exported from Jacksonville for each vessel call. However, in the existing condition, there are no PPX2 calls on any trade route servicing Jacksonville, and PPX1 calls are only on the FE-NA-SUEZ trade route. Therefore it was assumed that the all East-West PPX1 and PPX2 vessel calls use the FE-NA-SUEZ PPX1 parcel size proportion.

As shown in, there is a slight positive correlation between sailing draft and parcel size between 27 ft and 36 ft for SPX vessels. This is because these are smaller vessels on regional routes. A vessel is much more likely to have a larger proportion of its cargo dedicated to a smaller number of ports. As vessel sizes, route distances, and the number of ports on the itinerary increase, parcel sizes are less likely to be as large. Based on an examination of the existing condition dataset for Jacksonville Harbor, no evidence could be found to support a positive correlation between parcel size and sailing draft for PX1, PX2, and PPX1.

Table 2-20 provides detail on the number of port calls necessary to satisfy the demand for waterborne freight transportation in the existing condition. Analysis of these calls shows evidence of a preference for larger ship sizes. PX2 vessels begin calling in 2008 and by 2009 represent a plurality of the container fleet. Figure 2-23 provides greater detail. The fleet of vessels on the FE-ECUS-PAN and FE-ECUS-SUEZ routes are mostly PX2, or in the case of the Suez route, introducing PPX1 vessels. The fleet of vessels on the FE-EU-ECUS-GMEX route has been changing over time from SPX to PX vessels. The ECSA-ECUS fleet has also shown a slight shift to more PX1 and PX2 vessels.

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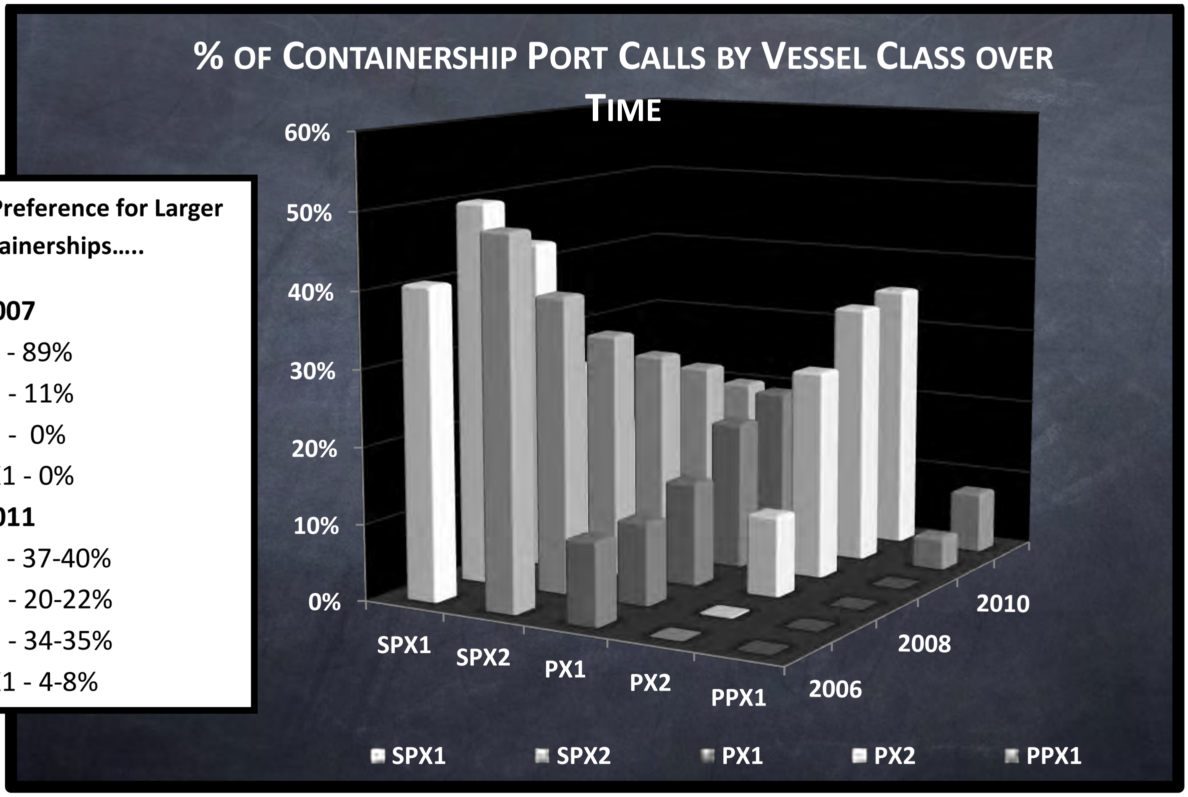
[17] Parcel Size: Size of the cargo consignment loaded and/or unloaded at the dock.

Table 2-19: Average Parcel Sizes in TEUs

Commodity	Vessel Class	2006	2007	2008	2009	2010
FE-ECUS-PAN	**PX1**				357	178
	PX2			337	558	464
FE-ECUS-SUEZ	**PX1**				124	83
	PX2			179	170	203
	PPX1					551
FE-EU-ECUS-GMEX	**SPX1**	185	180	231	208	269
	SPX2	306	729	778	234	315
	PX1	11		740	613	433
	PX2				674	204
ECSA-ECUS	**SPX1**	48	86	78	40	59
	SPX2	437			386	288
	PX1	1,045	966	912	556	564
	PX2				44	404
CAR-PR-JAX	**BARGE**	427	428	453	531	500
	SPX1	707	839	1,198	1,262	1,379
	SPX2	715	727	730	840	1,019
	RORO	553	648	564	614	800

Table 2-20: # Vessel Calls

Commodity	Vessel Class	2006	2007	2008	2009	2010
FE-ECUS-PAN	**PX1**			5	7	19
	PX2			28	84	110
FE-ECUS-SUEZ	**PX1**			1	9	10
	PX2			24	59	81
	PPX1					29
FE-EU-ECUS-GMEX	**SPX1**	146	144	122	93	53
	SPX2	70	43	28	31	49
	PX1	5		5	27	31
	PX2		1		15	28
ECSA-ECUS	**SPX1**	66	88	62	45	21
	SPX2	2			17	23
	PX1	53	55	56	79	87
	PX2				14	13
CAR-PR-JAX	**BARGE**	523	552	529	461	493
	SPX1	5	21	29	20	29
	SPX2	185	153	129	125	92
	RORO	178	151	175	166	144
	Total # Calls	**1233**	**1208**	**1193**	**1252**	**1312**



Side Note: Preference for Larger Containerships…..

- **2006-2007**
  - SPX - 89%
  - PX1 - 11%
  - PX2 - 0%
  - PPX1 - 0%
- **2010-2011**
  - SPX - 37-40%
  - PX1 - 20-22%
  - PX2 - 34-35%
  - PPX1 - 4-8%

Figure 2-23: Evidence of Fleet Transition

Draft	SPX1	SPX2	PX1	PX2	PPX1
13	1				
16	5				
17	5				
18	5	2			
19	24	2	1		
20	56	4			
21	79	5	1		
22	162	16	3		
23	215	18			
24	115	38			
25	66	87	1		
26	26	120	5		
27	25	173	10		
28	37	170	19	2	
29	16	91	43	4	
30	6	41	62	6	
31	1	23	66	20	
32		20	110	39	
33	2	10	33	98	1
34		4	20	45	2
35		4	11	61	5
36		1	2	29	5
37			2	42	27
38				31	8
39				5	9
40					1
TOTAL	846	829	389	382	58

Figure 2-24: Containership Sailing Draft Distribution

As shown in Figure 2-24, the correlation between channel capacity use and containership size is quite strong. As the vessel sizes increase, not only do they tend to sail deeper, but the range of operational drafts become smaller. The PPX1 sailing draft is slightly skewed to the bottom of the distribution, which suggests some tide riding behavior.

Analysis of the harbor pilot's data shows the following:

- All of the SPX calls are at Talleyrand and Blount Island
- Most of the PX1 vessels called Talleyrand
- Most PX2 vessels called Dames Point
- Virtually all of the PPX1 vessels called Dames Point

Table 2-21: Containership Calls by Terminal

SPX	
TMT-8-3	46%
BIMT-34-33	45%
BIMT-35	8%
BIMT-32-31-30	1%
PX	
TMT-8-3	53%
DPMT-16-17	31%
BIMT-34-33	8%
BIMT-35	7%
PPX	
DPMT-16-17	98%
BIMT-34-33	2%

2.3.3 DRY-BULK FREIGHT MOVEMENTS

Dry bulk cargoes moving through the port consist primarily of coal and construction materials. Table 2-22, provides detail on the distribution of dry bulk tonnage by commodity type. Most of the dry bulk cargo consists of coal receipts moving through the St Johns River Coal Terminal and coke receipts at the JEA Northside Plant. The coal terminal received roughly 90% of the coal/coke cargoes between 2006 and April of 2011. Figure 2-25 provides an illustration of the cargo volume moving through the harbor.

Dry bulk construction material volume moving through the harbor has been a declining percentage of bulker traffic. Table 2-22 provides detail on the distribution of dry bulk cargoes by cargo composition. Nearly 73% of these dry-bulk cargoes move through the Martin Marietta facility at Dames Point, and around 17% to private terminals located at the Chaseville Turn section of the Harbor.

Table 2-22: Dry-Bulk Cargo Volume and Composition

Commodity	2006-2010 Average	2006-2010 Total	%
COAL & COKE	3,394,641	16,973,207	61.1%
LIMESTONE CHIPS	515,826	2,579,132	9.3%
STONES & PEBBLES	138,341	691,707	2.5%
LIMESTONE	648,145	3,240,727	11.7%
GRANITE	490,543	2,452,715	8.8%
GYPSUM	368,413	1,842,063	6.6%
BULK POTASSIC FERT, PEAT MOSS	5,259	21,037	0.1%
Total Tonnes	**5,561,170**	**27,800,589**	**100%**

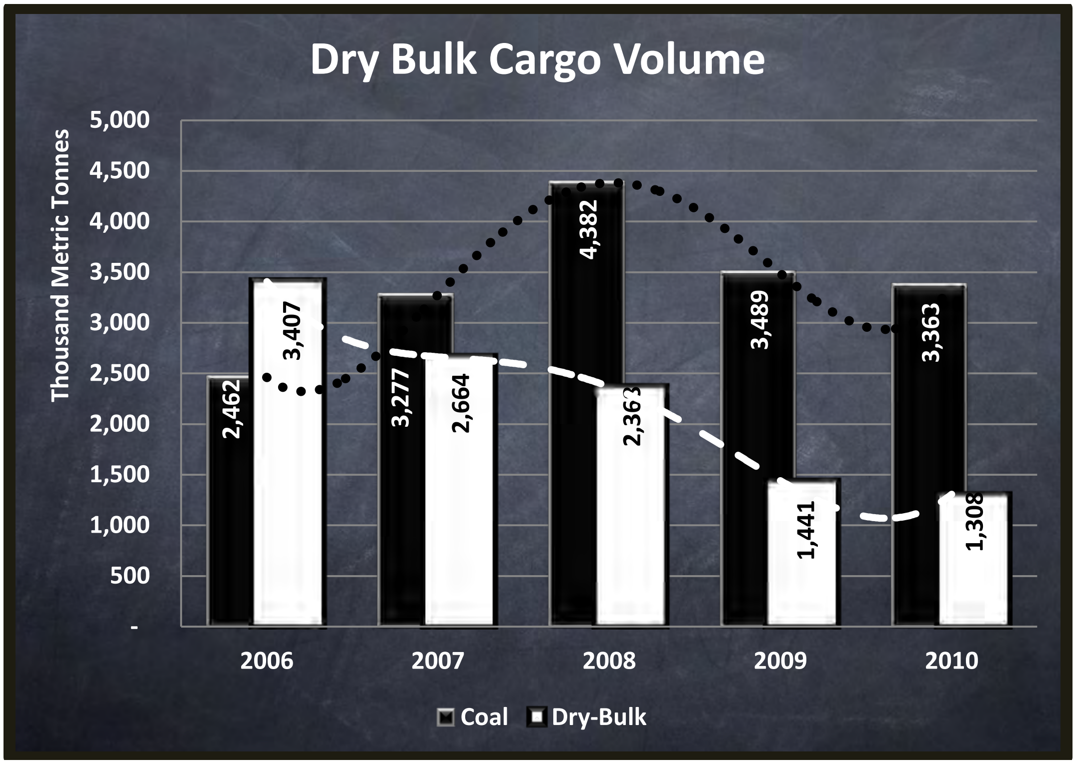


Figure 2-25: Dry Bulk Cargo Volume 2006-2010

Cargo Allocation by Vessel Class

Table 2-23 provides detail on the distribution of coal and dry-bulk by vessel class. By 2010, nearly 90% of the coal is moving on the two largest vessel classes. The 70-80k DWT Bulker class cargo allocation went from 400K in 2006 to nearly 1.5k in 2010. This implies a significant shift in vessel deployment practices.

Table 2-23: Bulker Cargo Allocation by Vessel Class

COAL

Class	2006	2007	2008	2009	2010	% 2010 Total
20-30k DWT Bulker	64,247	25,394				0%
30-40k DWT Bulker	41,652	251,550	67,550	29,434	71,151	2%
40-50k DWT Bulker	746,265	768,907	695,052	368,719	196,402	6%
50-60k DWT Bulker	1,044,288	1,233,177	1,244,072	171,368	116,081	3%
60-70k DWT Bulker	98,444	94,468	755,564	1,051,675	1,470,764	44%
70-80k DWT Bulker	400,584	839,865	1,620,082	1,867,510	1,473,125	44%
Total Tonnes	**2,395,481**	**3,213,361**	**4,382,320**	**3,488,706**	**3,327,524**	**100%**

DRY-BULK

Class	2006	2007	2008	2009	2010	% 2010 Total
10-20k DWT Bulker	119,361	134,525		55,550		0%
20-30k DWT Bulker	327,943	113,319	26,363			0%
30-40k DWT Bulker	797,318	477,378	387,082		35,605	3%
40-50k DWT Bulker	796,648	640,631	1,115,246	424,640	255,043	20%
50-60k DWT Bulker		268,227	114,352	71,074	46,063	4%
60-70k DWT Bulker	959,401	454,095	282,616	635,279	736,032	57%
70-80k DWT Bulker	224,794	455,297	363,796	250,774	224,990	17%
Total Tonnes	**3,225,465**	**2,543,472**	**2,289,455**	**1,437,318**	**1,297,732**	**100%**

Parcel Size, # Calls, and Sailing Draft

Table 2-24 displays data on the changes in coal and dry-bulk cargo parcels over time. Given the current channel constraints, the parcel sizes indicate that the vessels don't split their shipments between different ports. Each parcel is the entire shipload.

Table 2-24: Bulker Parcel Sizes

Commodity	Class	2006	2007	2008	2009	2010
Coal	20-30k DWT Bulker	32,124	25,394			
	30-40k DWT Bulker	20,826	35,936	33,775	29,434	35,575
	40-50k DWT Bulker	35,536	38,445	40,885	36,872	39,280
	50-60k DWT Bulker	49,728	49,327	42,899	42,842	38,694
	60-70k DWT Bulker	49,222	47,234	53,969	50,080	52,527
	70-80k DWT Bulker	57,226	39,994	57,860	50,473	56,659
Dry-Bulk	10-20k DWT Bulker	17,052	19,218		18,517	
	20-30k DWT Bulker	20,496	22,664	26,363		
	30-40k DWT Bulker	28,476	25,125	32,257		17,802
	40-50k DWT Bulker	41,929	42,709	44,610	38,604	42,507
	50-60k DWT Bulker		44,704	57,176	35,537	46,063
	60-70k DWT Bulker	47,970	45,410	56,523	45,377	52,574
	70-80k DWT Bulker	56,199	45,530	51,971	50,155	44,998

Table 2-25 provides detail on the number of vessel calls by vessel class delivering dry bulk cargoes.

Table 2-25: Existing Condition Bulker Calls

Commodity	Class	2006	2007	2008	2009	2010
Coal	20-30k DWT Bulker	2	1			
	30-40k DWT Bulker	2	7	2	1	2
	40-50k DWT Bulker	21	20	17	10	5
	50-60k DWT Bulker	21	25	29	4	3
	60-70k DWT Bulker	2	2	14	21	28
	70-80k DWT Bulker	7	21	28	37	26
Dry-Bulk	10-20k DWT Bulker	7	7		3	
	20-30k DWT Bulker	16	5	1		1
	30-40k DWT Bulker	28	19	12	1	2
	40-50k DWT Bulker	19	15	25	11	6
	50-60k DWT Bulker		6	2	2	1
	60-70k DWT Bulker	20	10	5	14	14
	70-80k DWT Bulker	4	10	7	5	5
Total Calls		**149**	**148**	**142**	**109**	**93**

Table 2-26 shows the sailing draft distribution for bulkers by vessel class. As the DWT of the vessels increase, the sailing draft distribution becomes more clustered at the channel capacity.

Table 2-26: Sailing Draft Distribution for Bulkers

Draft	10-20k DWT Bulker	20-30k DWT Bulker	30-40k DWT Bulker	40-50k DWT Bulker	50-60k DWT Bulker	60-70k DWT Bulker	70-80k DWT Bulker
17		1					
18		1					
19		1	2	2			
20	2	1	2	2			
21	2		4		1		
22	1	2	5	1	1		1
23	1	5	3	1	1		1
24	2	5	6	2	1		
25	1	3	6	1		1	
26	3	2	5	3			2
27		3	3	1			1
28		3	1	7			1
29	3	1	8	2	1	1	2
30	7	7	10	3	3	2	2
31	6	1	22	5	2	2	1
32	1	5	33	4	3	3	
33		3	2	4	1		1
34		3	7	5	3	4	5
35		22	16	41	17	20	8
36		3	4	26	10	10	6
37		5		76	14	22	18
38		1		25	23	24	46
39				12	35	57	84
40					3	3	10
Total Calls	29	78	139	223	119	149	189

2.3.4 SUMMARY OF THE EXISTING CONDITION INVENTORY

- **Components of Trade**
  - People & Economic Activity
  - Infrastructure
    - Road
    - Rail
    - Seaport
- **Facilities-(Represented in HarborSym)**
  - LSFs
    - **JEA-Coal Dock**
    - **Blount Island Marine Terminal**
      - **BIMT-35**
      - **BIMT-34-33**
      - **BIMT-32-31-30**
      - BIMT-22-20
    - JEA-Northside
    - **Dames Point Marine Terminal**
      - **DPMT-18**
      - **DPMT-17-16**
      - DPMT-10
    - BPOil-Hess
    - Navy Fuel Depot
    - US Gypsum-NuStar
    - TRNSM-CVRN
    - TMT-8-3
    - TMT-Crowley-Trumble
    - Commodores Point
  - **GNFs –Represented in HarborSym**
    - **St John's Bar Cut Range - West Section**
    - **Pilot Town Cut Range**
    - **Sherman Cut Range**
    - **Mayport Cut Range**
    - **Mile Point Lower Range and Turn**
    - **Training Wall Reach**
    - **Short Cut Turn**
    - **White Shells Cut Range**
    - **St John's Bluff Reach**
    - **Dames Point - Fulton Cutoff Range**
    - **Dames Point Turn**
    - **Quarantine / Upper Range**
  - **Trade Routes (Represented in HarborSym)**
    - **FE-ECUS-PAN**
    - **FE-ECUS-SUEZ**
    - **FE-EU-ECUS-GMEX**
    - **ECSA-ECUS**
    - **COAL-COMPOSITE**
    - **BULK-COMPOSITE**
- **Freight (Commodities represented in HarborSym)**
  - **Containers**
    - **FE-ECUS-PAN**
    - **FE-ECUS-SUEZ**
    - **FE-EU-ECUS-GMEX**
    - **ECSA-ECUS**
    - CAR-PR-JAX
  - **Dry-Bulk**
    - **COAL**
    - **DRY-BULK (Construction Materials)**
  - Other
    - LIQUID-BULK
    - PASSENGERS
- **Fleet-(Represented in HarborSym)**
  - **Container**
    - SPX1
    - SPX2
    - **PX1**
    - **PX2**
    - **PPX1**
    - **PPX2**
  - **Dry-Bulk**
    - 10-20k DWT Bulker
    - 20-30k DWT Bulker
    - 30-40k DWT Bulker
    - 40-50k DWT Bulker
    - **60-70k DWT Bulker**
    - **80-90k DWT Bulker**
    - **90-100k DWT Bulker**
  - **Tankers**
    - 10-20k DWT Tanker
    - 20-30k DWT Tanker
    - 30-40k DWT Tanker
    - 40-50k DWT Tanker
    - 60-70k DWT Tanker
    - 80-90k DWT Tanker
  - **Other**
    - REEFER
    - RORO
    - VEHICLE CARRIER
    - BARGE-GC-BULK
    - GC
    - 2k DWT Cruise
    - 2-6k DWT Cruise
    - 6-12k DWT Cruise
  - **Relevant Vessel Characteristics**
    - Cargo Capacity & Dimensions
    - Operating Cost
  - **Freight – Fleet – Facility Linkage**
    - Composition
    - Volume
    - Parcel
    - Sailing draft distribution

3 METHODS USED TO ESTIMATE THE FUTURE POSSIBILITIES

This section describes the processes used to estimate the transportation cost savings of each channel alternative. In the preceding sections we identified the relevant facilities, freight movements, vessel classes and trade routes in the inventory of the existing conditions. These items represent the components of transportation costs. Here we describe the process used to determine how those factors are likely to change in the future, and the effect of changes in channel depth/width are likely to have on the components of transportation costs. The following are and the chain of events that lead to transportation cost savings.

3.1 THE ECONOMIC MODELING OF THE JACKSONVILLE HARBOR GRR-II

This section describes the processes used to estimate the transportation cost savings of each channel alternative. In the preceding sections we identified the relevant facilities, freight movements, vessel classes and trade routes in the inventory of the existing conditions. Here we explore the theoretical underpinnings of transportation cost savings, determine the chain of events necessary to realize savings, and provide a brief overview of the modeling effort.

3.1.1 THEORETICAL UNDERPINNINGS OF TRANSPORTATION COST SAVINGS

The theoretical components of transportation costs are cargo, distance, time, and resistance. Cargo is the good for which freight transport is necessary due to spatial differences between traders. Distance represents the amount of space that the cargo must be moved. Time addresses the timeframe allotted to move the cargo. Resistance is the amount of effort that must be expended to facilitate the cargo movement. While the 1st 3 components of transportation costs are self explanatory, the third requires more of an explanation.

The resistance of a freight movement is the interplay between the aforementioned components (cargo, distance, and time) and the amount of physical and administrative effort required to facilitate the movement. Transportation cost is the opportunity cost of coordinating and executing a freight movement.

The role of infrastructure such as roads, rail, airports, and navigation channels is to reduce the resistance of moving people and/or freight. This economic analysis is an attempt to determine whether the proposed deepening and widening measures reduce the resistance of moving cargo at Jacksonville Harbor.

3.1.2 TRANSPORTATION COST SAVINGS CHAIN OF EVENTS

Consider the following hypothesis:" Deepening and widening the navigation channel at Jacksonville Harbor to a depth of x ft would be a wise infrastructure investment decision." What all must be true for us to fail to reject this hypothesis? Assuming the decision is made to deepen the channel one would expect the following to occur:

- **The existing draft constrained fleet will become more productive.** The current fleet of vessels with design drafts greater than 40' that call the coal terminal, Blount Island, or Dames Point will have access to a deeper range of transit drafts. It is probable that this portion of the fleet will make port calls utilizing a greater transit draft relative to the existing condition. The rationale for this is as follows:
  - Vessels sailing at a deeper draft implies a greater cargo load
  - A greater cargo load implies a greater deadweight utilization rate
  - A greater deadweight utilization rate increases the productivity of the voyage
  - A more productive voyage increases the revenue per DWT relative to the cost per DWT.
  - Therefore the carrier has an incentive to utilize as much capacity as much as practicable.

- **Fleet of vessels calling Jacksonville will shift to larger, more efficient ships.** The size of the world fleet of containerships continues to grow. As carriers consolidate slot capacity and use transshipment hubs to increase the ability to service a greater number of ports per voyage, the trend has been to employ larger vessels. Since, the universe of ships available for deployment is evolving in the direction of larger container vessels, these ships are bound to show up on routes servicing Jacksonville.

  Carriers have incentives to reduce the unit cost relative to unit revenue. Throughout the 20th century this has been done by the following:
  - **Increasing DWT:** The costs represented in the numerator of the equation don't increase in

REVENUE & PRODUCTIVITY

$$R = \frac{P * FR}{DWT}$$

Where:

- R= Revenue per deadweight tonne per year
- P = Productivity in tonne miles of cargo per year
- FR = Freight rate

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PRODUCTIVITY

$$P = 24 * S * LD * DWU$$

Where:

- P= Ship Productivity
- S = Average operating speed per hour
- LD = Loaded days at sea per year
- DWU = Deadweight tonnage utilization

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UNIT COSTS

$$C = \frac{OC + PM + VC + CHC + K}{DWT}$$

Where:

- C= Cost per deadweight tonne per year
- OC = Operating cost per year
- PM = Periodic maintenance cost per year
- VC = Voyage costs per year
- CHC = Cargo handling cost per year
- K = Capital costs per year
- DWT = Vessel deadweight in metric tonnes

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proportion to DWT. Therefore increasing the size of the vessel is a common method of reducing unit costs.
    - **Containerization:** The biggest reason for the explosion in the containerization of cargo is because it reduces cargo handling costs (CHC).
    - **Technological Advancement:** The larger, newer vessels are also incorporate technological advancements that reduce operating cost (OC) and voyage costs (VC). OC is reduced because newer vessels allow for a reduction in crew size. VC is reduced because newer ships tend to incorporate more advanced engines, reducing fuel consumption which can constitute over 40% of the cost of the voyage.
- The transportation cost savings will exceed the cost of deepening/widening the navigation channel.

OPERATING COSTS

$$OC = M + ST + I + AD$$

Where:

- OC= Operating costs
- M = Manning
- ST = Stores
- MN = Repair and maintenance
- I = Insurance
- AD= Administration

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CARGO HANDLING COSTS

$$CHC = L + DIS + CL$$

Where:

- CHC= Cargo handling costs
- L = Loading costs
- DIS = Discharge costs
- CL = Cargo Claims

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VOYAGE COSTS

$$VC = \mathrm{FC} + \mathrm{PD} + \mathrm{TP} + \mathrm{CD}$$

Where:

- VC= Voyage Costs
- FC= Fuel Costs
- PD= Port and Light Dues
- TP = Tugs and Pilotage
- CD= Canal Dues

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3.1.3 <u>OVERVIEW OF THE MODELING EFFORT</u>

The modeling effort was developed to measure the effect of a change in channel depth on the cost of cargo movement at Jacksonville Harbor. Primary benefits are anticipated to come from a fleet transition, and greater utilization of vessel deadweight capacity.

Channel depth can affect cargo movement cost because deeper channels allow carriers to have access to a greater proportion of the vessel's sailing draft distribution. A deeper vessel sailing draft is correlated with greater utilization of ship capacity, reducing the unit cost of freight movement. Thus, the focus of the modeling effort is the linkages between the cargo volume, alternatives /port facility changes, the sailing draft distribution, vessel capacity, and ultimately, the transportation cost.

3.1.4 <u>THE ALTERNATIVES:</u>

The purpose of this section is to provide a brief overview of the options considered to reduce transportation costs at Jacksonville harbor. The wideners and turning basins were necessary to allow the design vessel (Susan Maersk) to transit the channel. The project footprint was reduced to the 1st 13 river miles (See main report for details). Of particular concern here is the additional capacity the channel modifications will allow. The alternatives consist of the following:

- Wideners (Training Wall Reach, St John's Bluff)
- Turning Basins (Blount Island – River Mile 10-11; Brills Cut - River Mile 13)

- Deepening: All deepening alternatives include the wideners and the turning basins. The PDT evaluated depths ranging from 40 – 50 ft[18].

3.2 MODELING APPROACH

The approach to be taken is to base the estimation of transportation cost savings on the probability that a vessel of a particular class will make a port call at a certain sailing draft, channel depth permitting. The sailing draft will be selected at random from a cumulative probability distribution of vessel arrivals to and departures from East Coast ports. This distribution was developed from Waterborne Commerce Statistics Entrances and Clearances data for 2007 through 2010.

The distribution represents a wide variety of vessel arrivals and departures between ports on the U.S. East Coast and trading partners located around the world. While it is known that many of these vessel calls are to and from ports that are not on trade routes servicing Jacksonville, this approach is used for the following reasons:

- It provides an empirical basis to reflect the universe of future sailing draft possibilities over the period of analysis.
- It is the easiest way to represent the complexity of container shipping.

Vessels that sail at a deeper draft tend to do so because they are utilizing more of their deadweight cargo capacity. Thus, the more cargo there is aboard the vessel per voyage, the lower the unit cost of commodity movement. This is true irrespective of the size of the cargo parcel to be delivered to any particular port. The implication is that a Panamax vessel with a 45 ft design draft sailing at 43 feet to deliver a cargo parcel of 400 TEUs will do so at a lower unit cost than the same ship delivering the same size parcel, but sailing at 39 ft. This proposition forms the basis for the transportation cost and cost per tonne of cargo calculations as shown here:

$$\mathbf{Jax_{TC} = V_{TC} * (P/ETTC_{SD})}$$

$$\mathbf{Jax_{CPT} = Jax_{TC} / P}$$

Where

- **Jax_{TC}** = Jacksonville freight transportation cost in dollars
- **V_{TC}** = Total voyage cost
- **P** = Cargo parcel[19] size in metric tonnes
- **$ETTC_{SD}$** = Estimated total trip cargo implied by the sailing draft
- **Jax_{CPT}=** Jacksonville freight transportation cost per metric tonne

As shown in the equations above, an increase in the **$ETTC_{SD}$** of the vessel will reduce the cost of commodity movement per metric tonne of freight delivered. Deepening the navigation channel provides greater access to the universe of future possible sailing drafts.

NED benefits are the transportation cost savings defined by the difference between the cost of commodity movement through JaxPort in the future without and future with project conditions. The steps used in the modeling effort to estimate these benefits include: 1) representing the system being modeled; 2) incorporating the sailing draft distribution; and 3) development of the future with and without project condition port traffic.

[18] The 40ft turning basin and widening only option is separate from the future without project condition 40ft depth.

[19] Parcel is used to describe the size of the cargo shipment to be loaded and unloaded during the vessel call.

3.3 REPRESENTING THE SYSTEM

Representing the system includes developing the trade routes, cargo categorizations, vessel classes, and port infrastructure within the HarborSym environment. The port infrastructure is manipulated into different scenarios to model the different channel configuration alternatives. USACE-SAJ district, working through JaxPort, the local sponsor, developed a commodity and fleet forecast using IHS Global Insight and Maritime Strategies International (MSI) respectively.

3.3.1 TRADE UNITS

Conceptually, a trade unit is the combination of all the components necessary to execute a maritime trade transaction (arrival – load/discharge cargo – departure). Those components are the following:

- **Trade Route** – component that implies the source/destination route linking trade regions, maritime chokepoints, and distance the freight must travel
- **Cargo** – Represents object(s) of human desire and impetus for all trade
- **Vessel Class** – Capital implement used to move waterborne cargo from supplier to demander.
- **Dock** – Facility representing the location at the study port where the load/discharge event takes place.

A matrix was used to represent all reasonable trade unit possibilities using the following structure:

Trade Unit = Route * Cargo * Vessel Class * P (Dock | Vessel Class)

Thus, the route-cargo-vessel class is associated with the probability of a certain number of docks given a vessel class. This probability was developed from the existing condition dataset. X provides more detail on the association of the vessel class to vessel class associations.

Table 3-1: P (Dock | Vessel Class)

P(Dock | Class)[20]	Dock	Vessel Class Name	%	Frequency
-	BIMT-34-33	SPX1	30%	199
0.30	BIMT-35	SPX1	5%	34
0.36	TMT-8-3	SPX1	64%	423
-	BIMT-34-33	SPX2	65%	437
0.65	BIMT-35	SPX2	6%	43
0.72	TMT-8-3	SPX2	28%	188
-	TMT-8-3	PX1	100%	334
-	BIMT-34-33	PX2	13%	42
0.13	BIMT-35	PX2	14%	43
0.27	DPMT-16-17	PX2	60%	188
0.87	TMT-8-3	PX2	13%	40
-	DPMT-16-17	PPX1	60%	60
0.60	BIMT-34-33	PPX1	40%	40
-	DPMT-16-17	PPX2	70%	70
0.70	BIMT-34-33	PPX2	30%	30

[20] P (Dock | Vessel Class): Probability of a call to a dock given a particular vessel class. For the PPX2, which has never called Jacksonville, it was assumed 70% of the vessels would call Dames Point.

Figure 3-1 represents the trade unit component pieces as extracted from the existing condition inventory.

Route Grouping	Cargo	Vessel Class	Dock
• FE-ECUS-PAN	• FE-ECUS-PAN	• SPX1	• USMC Terminal
• FE-ECUS-SUEZ	• FE-ECUS-SUEZ	• SPX2	• JEA-CoalDock
• FE-EU-ECUS-GMEX	• FE-EU-ECUS-GMEX	• PX1	• BIMT-35
• ECSA-ECUS	• ECSA-ECUS	• PX2	• BIMT-34-33
• COAL-COMPOSITE	• COAL	• PPX1	• BIMT-32-31-30
• DRYBULK-COMPOSITE	• DRY-BULK	• PPX2	• BIMT-22-20
• INCIDENTAL	• LIQUID-BULK	• REEFER	• JEA-Northside
	• CAR-PR-JAX	• RORO	• DPMT-18
	• AUTOS	• VEHICLES CARRIER	• DPMT-17-16
	• PASSENGERS	• GC	• DPMT-10
		• BARGE-GC-BULK	• BPOil-Hess
		• BARGE-TANK	• NavyFuelDepot
		• 10-20k DWT Bulker	• USGypsum-NuStar
		• 20-30k DWT Bulker	• TRNSM-CVRN
		• 30-40k DWT Bulker	• TMT-8-3
		• 40-50k DWT Bulker	• TMT-Crowley-Trumble
		• 50-60k DWT Bulker	• CommodoresPoint
		• 60-70k DWT Bulker	
		• 70-80k DWT Bulker	
		• 80-90k DWT Bulker	
		• 90-100k DWT Bulker	
		• 10-20k DWT Tanker	
		• 20-30k DWT Tanker	
		• 30-40k DWT Tanker	
		• 40-50k DWT Tanker	
		• 50-60k DWT Tanker	
		• 60-70k DWT Tanker	
		• 70-80k DWT Tanker	
		• 80-90k DWT Tanker	
		• 90-100k DWT Tanker	
		• 2k DWT Cruise	
		• 2-6k DWT Cruise	
		• 6-12k DWT Cruise	

Figure 3-1: Trade Unit Components represented in HarborSym

The trade unit allows the past present and future commodity volume, fleet transition, sailing draft distributions, fleet characteristics, channel depth alternatives, and port facility usage information to be linked to a single point of reference. As the cargo volume, fleet mix, and/or channel depth change over time, one can determine the affect on the number of trade units needed to move the forecasted trade volume. Table x provides detail on the container and general cargo trade units. Table xx provides greater detail on coal, dry-bulk, liquid bulk, and auto trade units.

Table 3-2: Trade Unit Matrix for Container and General Cargo

Trade ID Reference	Vessel Class	Commodity Name	Route Group Name	Dock Reference	Trade Unit Code
1	PX1	FE-ECUS-PAN	FE-ECUS-PAN	JAXDock3	TEU-1|RT-1|PX1
2	PX2	FE-ECUS-PAN	FE-ECUS-PAN	JAXDock4	TEU-1|RT-1|PX2
3	PPX1	FE-ECUS-PAN	FE-ECUS-PAN	JAXDock5	TEU-1|RT-1|PPX1
4	PPX2	FE-ECUS-PAN	FE-ECUS-PAN	JAXDock6	TEU-1|RT-1|PPX2
5	SPX1	FE-ECUS-SUEZ	FE-ECUS-SUEZ	JAXDock1	TEU-3|RT-3|SPX1
6	SPX2	FE-ECUS-SUEZ	FE-ECUS-SUEZ	JAXDock2	TEU-3|RT-3|SPX2
7	PX2	FE-ECUS-SUEZ	FE-ECUS-SUEZ	JAXDock4	TEU-3|RT-3|PX2
8	PPX1	FE-ECUS-SUEZ	FE-ECUS-SUEZ	JAXDock5	TEU-3|RT-3|PPX1
9	PPX2	FE-ECUS-SUEZ	FE-ECUS-SUEZ	JAXDock6	TEU-3|RT-3|PPX2
10	SPX1	FE-EU-ECUS-GMEX	FE-EU-ECUS-GMEX	JAXDock1	TEU-2|RT-2|SPX1
11	SPX2	FE-EU-ECUS-GMEX	FE-EU-ECUS-GMEX	JAXDock2	TEU-2|RT-2|SPX2
12	PX1	FE-EU-ECUS-GMEX	FE-EU-ECUS-GMEX	JAXDock3	TEU-2|RT-2|PX1
13	PX2	FE-EU-ECUS-GMEX	FE-EU-ECUS-GMEX	JAXDock4	TEU-2|RT-2|PX2
14	PPX1	FE-EU-ECUS-GMEX	FE-EU-ECUS-GMEX	JAXDock5	TEU-2|RT-2|PPX1
15	PPX2	FE-EU-ECUS-GMEX	FE-EU-ECUS-GMEX	JAXDock6	TEU-2|RT-2|PPX2
16	SPX1	ECSA-ECUS	ECSA-ECUS	JAXDock1	TEU-4|RT-4|SPX1
17	SPX2	ECSA-ECUS	ECSA-ECUS	JAXDock2	TEU-4|RT-4|SPX2
18	PX1	ECSA-ECUS	ECSA-ECUS	JAXDock3	TEU-4|RT-4|PX1
19	PX2	ECSA-ECUS	ECSA-ECUS	JAXDock4	TEU-4|RT-4|PX2
20	PPX1	ECSA-ECUS	ECSA-ECUS	JAXDock5	TEU-4|RT-4|PPX1
21	BARGE-GC-BULK	CAR-PR-JAX	INCIDENTAL	JAXDock11	TEU-5|FI|BARGE-DRY
22	SPX1	CAR-PR-JAX	INCIDENTAL	JAXDock1	TEU-5|FI|SPX1
23	SPX2	CAR-PR-JAX	INCIDENTAL	JAXDock2	TEU-5|FI|SPX2
24	RORO	CAR-PR-JAX	INCIDENTAL	JAXDock8	TEU-5|FI|RORO
25	REEFER	GENERAL-CARGO	INCIDENTAL	JAXDock7	TEU-5|FI|REEFER
26	VEHICLES CARRIER	GENERAL-CARGO	INCIDENTAL	JAXDock9	TEU-5|FI|VC
27	GC	GENERAL-CARGO	INCIDENTAL	JAXDock10	TEU-5|FI|GC

Table 3-3: Coal, Dry-Bulk, Liquid-Bulk, & Vehicular Trade Units

Trade Unit ID	Vessel Class	Commodity Name	Route Group Name	Dock Reference	Trade Code
28	10-20k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock13	DB|RT-5|20k DWT Bulk
29	20-30k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock14	DB|RT-5|30k DWT Bulk
30	30-40k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock15	DB|RT-5|40k DWT Bulk
31	40-50k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock16	DB|RT-5|50k DWT Bulk
32	50-60k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock17	DB|RT-5|60k DWT Bulk
33	60-70k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock18	DB|RT-5|70k DWT Bulk
34	70-80k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock19	DB|RT-5|80k DWT Bulk
35	80-90k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock20	DB|RT-5|90k DWT Bulk
36	90-100k DWT Bulker	COAL	COAL-COMPOSITE	JAXDock21	DB|RT-5|100k DWT Bulk
37	10-20k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock13	DB|RT-6|20k DWT Bulk
38	20-30k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock14	DB|RT-6|30k DWT Bulk
39	30-40k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock15	DB|RT-6|40k DWT Bulk
40	40-50k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock16	DB|RT-6|50k DWT Bulk
41	50-60k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock17	DB|RT-6|60k DWT Bulk
42	60-70k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock18	DB|RT-6|70k DWT Bulk
43	70-80k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock19	DB|RT-6|80k DWT Bulk
44	80-90k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock20	DB|RT-6|90k DWT Bulk
45	90-100k DWT Bulker	DRY-BULK	BULK-COMPOSITE	JAXDock21	DB|RT-6|100k DWT Bulk
46	BARGE-TANK	LIQUID-BULK	INCIDENTAL	JAXDock12	LB|FI|BARGE-TANK
47	10-20k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock22	LB|FI|20k DWT Tank
48	20-30k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock23	LB|FI|30k DWT Tank
49	30-40k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock24	LB|FI|40k DWT Tank
50	40-50k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock25	LB|FI|50k DWT Tank
51	50-60k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock26	LB|FI|60k DWT Tank
52	60-70k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock27	LB|FI|70k DWT Tank
53	70-80k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock28	LB|FI|80k DWT Tank
54	80-90k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock29	LB|FI|90k DWT Tank
55	90-100k DWT Tanker	LIQUID-BULK	INCIDENTAL	JAXDock30	LB|FI|100k DWT Tank
56	6-12k DWT Cruise	PASSENGERS	INCIDENTAL	JAXDock33	PASS|FI|Cruise-3
57	RORO	AUTOS	INCIDENTAL	JAXDock8	AUTO|FI|RORO
58	BARGE-GC-BULK	AUTOS	INCIDENTAL	JAXDock11	AUTO|FI|BARGE-DRY
59	VEHICLES CARRIER	AUTOS	INCIDENTAL	JAXDock9	AUTO|FI|VC

3.3.2 FUTURE PORT TRAFFIC

The purpose served by developing future port traffic is to represent traffic movement in and out of the harbor over the period of analysis. This is accomplished by incorporating the cargo forecast, fleet transition, sailing draft distribution, and parcel size data into the trade unit. A vessel call list is generated in yearlong increments interspersed throughout the period of analysis, and ran through HarborSym. The steps to building the call list are as follows:

- Determine the annual cargo volume & composition
- Allocate annual cargo volume by trade unit
- Determine the amount of cargo brought in per vessel call using historical percentages
- Estimate the number of vessel calls

- Apply the sailing draft distribution to the vessel calls
- Determine the **ETTC$_{SD}$**

3.3.2.1 *FUTURE CARGO VOLUME & COMPOSITION:*

Global economic growth is anticipated to slow over the next several years due to the sovereign debt crisis occurring in the Euro- zone. Total U.S. exports and imports are anticipated to expand at an average annual rate of 1.46% and 2.25% respectively through 2060. Import and export tonnages at the Port of Jacksonville are recovering after the Great Recession of 2008-2009, which saw a drop of around 30% for imports and 8% for exports. Imports are projected to increase from 10.0 million tons in 2010 to 22.0 million tons by 2060. Exports are projected to grow from 4.9 million tons in 2010 to 14.6 million tons by 2060. Dry bulk and containerized cargo have the highest share and are expected to grow faster over time relative to liquid bulk and general cargo. Coal from Colombia is projected to remain at around 4 million metric tonnes for the entire forecast period commensurate with electricity generation needs. Containerized cargo is anticipated to be the most prominent import for the Port of Jacksonville over the period of analysis. Table X provides detail on the commodity growth rates while Table X1 provides the forecasted commodity TEUS and tonnages. The forecasted tonnages are based on a commodity forecast completed by Global Insight.

Once the trade routes were organized, they were associated with the countries that constitute Jacksonville's trading partners in the PIERS data and the Global Insight commodity forecast. Aggregating the forecasted volume of the trade partner into the route allows the "trade" to be grown over the period of analysis. As a result, the cargo categories have the same nomenclature as the trade routes within the HarborSym environment. Upon incorporating the commodity forecast into the trade route, TEUS, tonnages, and growth rates for each trade can then be estimated for the period of analysis.

Table 3-4: Commodity Forecast based on Global Insight

UNITS	Commodity Name	2020	2030	2040	2050
TEUS	FE-ECUS-PAN	155,031	277,703	362,482	475,925
	FE-ECUS-SUEZ	56,483	95,934	128,908	175,157
	FE-EU-ECUS-GMEX	107,922	143,351	183,954	239,964
	ECSA-ECUS	108,947	168,913	237,435	338,440
	CAR-PR-JAX	445,978	447,636	449,295	450,961
Tonnes	GENERAL-CARGO	1,405,995	1,788,623	2,209,429	2,209,429
	COAL[21]	5,071,033	5,424,134	6,521,746	6,521,746
	DRY-BULK	2,359,793	2,695,416	3,084,247	3,084,247
	LIQUID-BULK	4,522,288	4,937,923	5,385,516	5,385,516
	AUTOS	1,513,216	2,036,165	2,700,377	2,700,377

Based on the information presented in Table 3-4, throughput on the East –West route along with the ECSA-ECUS trade is forecasted to become the dominant container trades for the Jacksonville Harbor. Growth on the FE-ECUS-PAN, FE-ECUS-SUEZ, and ECSA-ECUS appear to be the most aggressive. The Puerto Rican trade growth is relatively flat. The FE-ECUS-PAN category makes up over 49% of the total East-West Trade, followed by FE-EU-ECUS-GMEX (33%), and FE-ECUS-SUEZ (17%).

[21] Coal was kept constant at 4,000,000 metric tonnes per year based on interviews with the terminal operator. Depicted in the table are

The composition of containerized cargo trade flows on the East-West routes at Jacksonville Harbor is range from 41% to 57% import and 43% to 59% export. Imported cargoes are made up of consumer and manufactured goods. The biggest exports consist of forestry, metal & scrap, and food and farm products.

North-South trade flow composition is predominantly export in nature, with the overwhelming majority of the throughput on the ECSA-ECUS route. Exports are over 70% of trade flows. Major exports consist of chemicals, machines & manufactured goods, vehicles & parts, and forestry products.

Table 3-5 provides detail on the estimation of laden cargo per container in metric tonnes per TEU. Table 2-15 provides detail on the distribution of imports vs. exports per trade. Table 3-7 provides a breakdown of the

Table 3-5: Laded Cargo Tonnes per TEU Imports, Exports, and Weighted

Route-Cargo	I	E	I/E
FE-ECUS-PAN	6.26	9.69	7.71
FE-ECUS-SUEZ	7.25	8.96	8.11
FE-EU-ECUS-GMEX	9.32	8.44	8.78
ECSA-ECUS	8.05	7.55	7.71
CAR-PR-JAX	6.43	7.95	7.67

Table 3-6: Containers: Import vs. Exports

Route-Cargo	Import /Inbound	Export / Outbound
FE-ECUS-PAN	57%	43%
FE-ECUS-SUEZ	50%	50%
FE-EU-ECUS-GMEX	41%	59%
ECSA-ECUS	29%	71%
CAR-PR-JAX	18%	82%

Table 3-7: Composition of Container Cargo based on GI Forecast

	Commodity	ECSA-ECUS	FE-ECUS-PAN	FE-ECUS-SUEZ	FE-EU-ECUS-GMEX
EXPORT TEU COMPOSITION	Chemicals	25%	12%	17%	18%
	Construction Materials	1%	0%	1%	2%
	Consumer Goods	3%	0%	1%	5%
	Food & Farm Products	8%	26%	7%	31%
	Forestry Products	15%	33%	18%	18%
	Machines & Manufactured Goods	23%	2%	13%	11%
	Metal Products & Scrap Metal	5%	26%	32%	8%
	Other Cargo	0%	0%	0%	2%
	Petroleum Products	1%	0%	0%	1%
	Vehicles & Parts	19%	0%	11%	3%
IMPORT TEU COMPOSITION	**Commodity**	**ECSA-ECUS**	**FE-ECUS-PAN**	**FE-ECUS-SUEZ**	**FE-EU-ECUS-GMEX**
	Chemicals	20%	12%	3%	23%
	Construction Materials	0%	0%	0%	16%
	Consumer Goods	12%	32%	45%	2%
	Food & Farm Products	27%	10%	33%	11%
	Forestry Products	21%	5%	2%	32%
	Machines & Manufactured Goods	7%	24%	8%	6%
	Metal Products & Scrap Metal	6%	10%	8%	6%
	Other Cargo	1%	0%	0%	2%
	Petroleum Products	0%	0%	0%	3%
	Vehicles & Parts	6%	7%	1%	1%

commodity composition per import and export trade. Based on the information presented in these tables, the exported cargoes would tend to be heavier than the imported freight. For modeling purposes, a weighted average of the imported and exported tonnage per TEU over the period of analysis was used in the specification of cargo lading per TEU. The percentage import vs. export distribution was used in the estimation of the number of imported TEUS vs. exported TEUS within the parcel.

Comparison of the Piers data the proportion of empties in each cargo parcel was relatively small. Comparison of the existing condition PIERS dataset with Global Insight revealed relatively similar laden container weights.

3.3.2.2 FUTURE FLEET COMPOSITION

The role of the fleet transition is to apportion the future cargo volume per trade unit by the vessels anticipated to facilitate the trade. A fleet transition depends on the mix of vessels anticipated to be available for use during the period of analysis. Thus, in order to inform the transition, a fleet forecast was conducted by MSI.

MSI's method essentially links GDP to the fleet by 1st linking GDP growth to trade, and then linking trade growth to fleet development. Change in the fleet composition is determined by investment / divestment dynamics. Consequently MSI's equation for estimating the balance of vessels in the world fleet inventory is looked at on an annual basis as follows

$$\textbf{Fleet}_{(t)} = \textbf{Fleet}_{(t-1)} + \textbf{Deliveries}_{(t)} - \textbf{Scrapping}_{(t-1)}$$

Where

$\textbf{Fleet}_{(t)}$ = Fleet at end of year t
$\textbf{Fleet}_{(t-1)}$ = Fleet at end of previous year
$\textbf{Deliveries}_{(t)}$ = Deliveries of new builds
$\textbf{Scrapping}_{(t-1)}$ = Number of ships scrapped the previous year

Essentially the fleet at the end of a given year equals the fleet from the previous year plus new builds of the current year less the vessels scrapped during the previous year. Figure 3-2 provides an illustration of the expected growth in containership capacity up to 2025.
According to MSI, there is a significant oversupply of TEU capacity coupled with a weak earnings environment. The following excerpt from the MSI forecast provides a succinct description of the net effect of the surplus capacity on deployment. The outputs of the MSI fleet forecast was an estimated # of vessel calls by class forecasted out to 2040.

"However, with head haul Asia-Europe trade growth stalling there is increasing pressure to cascade Post-Panamax vessels from the Asia-Europe trade onto other major trades such as the Transpacific, Transatlantic, Asia-Middle East/Indian Subcontinent or Asia-Latin America trades. The arrivals of these Post-Panamax vessels in turn displace the Panamax vessels onto other North-South trades, triggering a further round of cascading of smaller vessels onto intra-regional trades."

"This cascade has of course always been an integral part of allocating container shipping capacity and growing the fleet. What is different in the current market is the extent to which vessels are being pushed onto trades where they will be unable to operate at maximum efficiency (or indeed in some cases, at maximum utilization due to port constraints)."

Maritime Strategies International

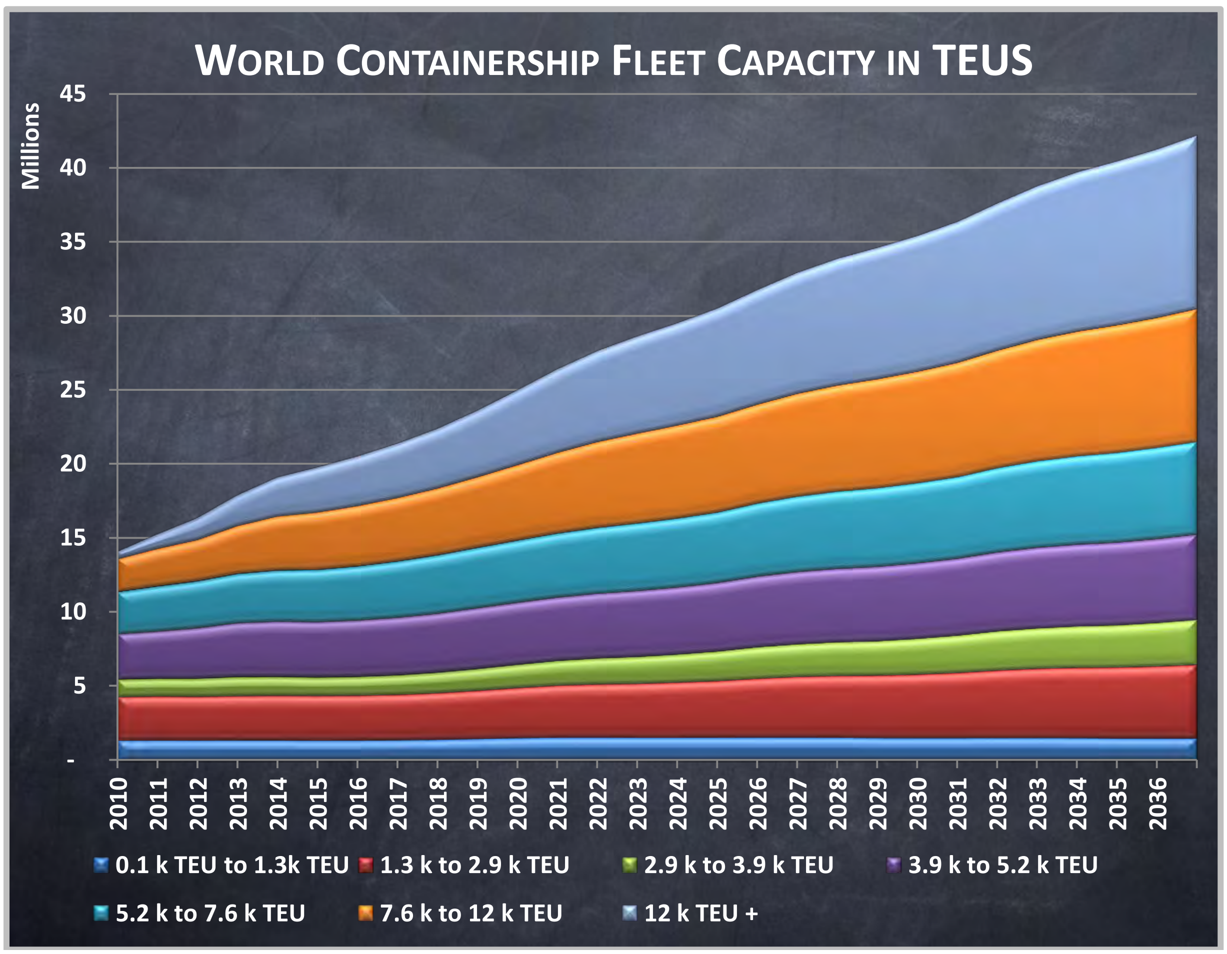

Figure 3-2: Containership Fleet Forecast (MSI)

- **The containership fleet transitions in the following three depth ranges:**
  - **40-41 ft** – No PPX2 vessel calls on services to ports within this depth range over the period of analysis. However, PPX1 vessels supplant PX2, as the workhorse of the fleet.
  - **42-43 ft** – PPX2 vessels begin calling at ports with at least 42 ft of depth. Empirical data suggest this is indeed the case. Port Everglades, with a project depth of 42' is beginning to see PPX2 vessels. PPX2 deployments to ports within this depth range will remain moderate, reflecting carrier preferences to avoid channel constraints on operations.
  - **44-50 ft –** This depth range has the most aggressive transition of fleet to PPX2 size vessels. At 44' and beyond the PPX2 can utilize enough of its deadweight cargo capacity to warrant significant deployments to ports operating within this range of depths.

Table 3-8 provides detail on the fleet transition for container vessels.

Table 3-8: Fleet Transition for Containers

Commodity Name	Vessel Class	40-41	42-43	44	45-49	50
FE-ECUS-PAN	PX1	7.3%	6.9%	4.9%	4.9%	4.9%
FE-ECUS-PAN	PX2	25.9%	21.3%	5.1%	5.1%	5.1%
FE-ECUS-PAN	PPX1	65.2%	35.9%	19.5%	19.5%	19.5%
FE-ECUS-PAN	PPX2	0.0%	34.3%	68.9%	68.9%	68.9%
FE-ECUS-PAN	RORO	1.6%	1.6%	1.6%	1.6%	1.6%
FE-ECUS-SUEZ	SPX1	0.6%	1.0%	1.0%	1.0%	1.0%
FE-ECUS-SUEZ	SPX2	1.9%	1.7%	1.7%	1.7%	1.7%
FE-ECUS-SUEZ	PX2	26.9%	22.0%	5.1%	5.1%	5.1%
FE-ECUS-SUEZ	PPX1	67.6%	37.0%	19.7%	19.7%	19.7%
FE-ECUS-SUEZ	PPX2	0.0%	35.3%	69.5%	69.5%	69.5%
FE-ECUS-SUEZ	RORO	0.5%	0.5%	0.5%	0.5%	0.5%
FE-ECUS-SUEZ	GC	2.6%	2.6%	2.6%	2.6%	2.6%
FE-EU-ECUS-GMEX	SPX1	17.6%	17.4%	18.0%	18.0%	18.0%
FE-EU-ECUS-GMEX	SPX2	24.2%	24.0%	24.6%	24.6%	24.6%
FE-EU-ECUS-GMEX	PX1	8.4%	12.1%	3.0%	3.0%	3.0%
FE-EU-ECUS-GMEX	PX2	14.2%	20.4%	3.0%	3.0%	3.0%
FE-EU-ECUS-GMEX	PPX1	35.6%	19.5%	11.3%	11.3%	11.3%
FE-EU-ECUS-GMEX	PPX2	0.0%	0.0%	40.1%	40.1%	40.1%
ECSA-ECUS	SPX1	9.3%	9.3%	9.3%	9.3%	9.3%
ECSA-ECUS	SPX2	11.2%	11.2%	11.2%	11.2%	11.2%
ECSA-ECUS	PX1	10.2%	10.2%	10.2%	10.2%	10.2%
ECSA-ECUS	PX2	17.3%	17.3%	17.3%	17.3%	17.3%
ECSA-ECUS	PPX1	43.5%	43.5%	43.5%	43.5%	43.5%
ECSA-ECUS	GC	8.3%	8.3%	8.3%	8.3%	8.3%

- **Bulkers Fleet Transition**
  - **40-44 ft** – Vessels utilize more of their capacity but the mix vessel classes does not change until a project depth of 45’.
  - **45-49 ft** – 80-90k DWT Bulker vessels can utilize enough cargo capacity to begin calling on a regular basis.
  - **50 ft** – 90-100k DWT Bulker vessels begin making port calls on a regular basis.

Table 3-9 provides detail on the fleet transition for bulkers.

Table 3-9: Bulker Fleet Transition

Commodity Name	Vessel Class	40-41’	42-43’	44’	45-49’	50’
Coal	10-20k DWT Bulker	0.0%	0.0%	0.0%	0.0%	0.0%
Coal	20-30k DWT Bulker	0.0%	0.0%	0.0%	0.0%	0.0%
Coal	30-40k DWT Bulker	1.9%	1.9%	1.9%	0.0%	0.0%
Coal	40-50k DWT Bulker	6.9%	6.9%	6.9%	1.6%	0.8%
Coal	50-60k DWT Bulker	12.5%	12.5%	12.5%	8.0%	6.9%
Coal	60-70k DWT Bulker	41.0%	41.0%	41.0%	12.4%	8.0%
Coal	70-80k DWT Bulker	37.8%	37.8%	37.8%	43.9%	9.7%
Coal	80-90k DWT Bulker	0.0%	0.0%	0.0%	34.0%	45.2%
Coal	90-100k DWT Bulker	0.0%	0.0%	0.0%	0.0%	29.4%
Dry-Bulk	10-20k DWT Bulker	0.6%	0.6%	0.6%	0.3%	0.3%
Dry-Bulk	20-30k DWT Bulker	2.9%	2.9%	2.9%	1.6%	1.3%
Dry-Bulk	30-40k DWT Bulker	9.8%	9.8%	9.8%	8.0%	7.5%
Dry-Bulk	40-50k DWT Bulker	31.1%	31.1%	31.1%	19.9%	17.7%
Dry-Bulk	50-60k DWT Bulker	9.8%	9.8%	9.8%	21.3%	17.9%
Dry-Bulk	60-70k DWT Bulker	24.3%	24.3%	24.3%	12.5%	15.8%
Dry-Bulk	70-80k DWT Bulker	21.5%	21.5%	21.5%	20.2%	11.1%
Dry-Bulk	80-90k DWT Bulker	0.0%	0.0%	0.0%	16.3%	16.8%
Dry-Bulk	90-100k DWT Bulker	0.0%	0.0%	0.0%	0.0%	11.6%

3.3.2.3 PARCEL SIZE & # OF PORT CALLS

The next step in the process was to determine the number of vessel calls needed to accommodate the forecasted trade volume. Using the historic distribution of cargo parcel sizes, a representative cargo parcel was chosen to be the baseline parcel size for each trade unit. The ratio of the baseline parcel to the arrival draft capacity was then used to determine a theoretical parcel size used to distribute the annual cargo volume throughout the forecast year.

% Vessel Capacity = Baseline Cargo Parcel Size / Capacity implied by Maximum Arrival Draft | 40ft Channel Depth

This proportion of vessel capacity forms the basis for the parcel sizes calculated for all channel depth alternatives. For example, to determine the theoretical parcel size for a PPX2 given a 45ft channel depth entails the following:

Theoretical Parcel Size = % Vessel Capacity x Capacity implied by Maximum Arrival Draft | 45 ft Channel Depth

Next we divide the annual trade unit cargo volume by the theoretical parcel size to get the number of port calls for the trade unit.

 # Port Calls = Annual Trade Unit Cargo Volume / Theoretical Parcel Size

Table 3-10 shows the number of vessel calls estimated for 2020.

Table 3-10: # Calls Estimated for 2020

	2020						
Vessel Class Name	**40ft**	**42ft**	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
SPX1	116	115	116	116	116	116	116
SPX2	172	172	172	172	172	172	172
PX1	88	86	81	81	81	81	81
PX2	210	179	159	159	159	159	159
PPX1	287	175	168	166	165	165	165
PPX2	0	75	87	85	81	78	78
REEFER	15	15	15	15	15	15	15
RORO	254	254	254	254	254	254	254
VEHICLES CARRIER	609	609	609	609	609	609	609
GC	120	120	120	120	120	120	120
BARGE-GC-BULK	475	475	475	475	475	475	475
BARGE-TANK	32	32	32	32	32	32	32
10-20k DWT Bulker	1	1	1	0	0	0	0
20-30k DWT Bulker	3	3	3	2	2	2	1
30-40k DWT Bulker	8	8	8	5	5	5	4
40-50k DWT Bulker	22	22	22	13	13	13	10
50-60k DWT Bulker	15	13	13	15	15	15	13
60-70k DWT Bulker	42	39	36	13	12	12	11
70-80k DWT Bulker	35	32	29	33	32	31	10
80-90k DWT Bulker	0	0	0	22	21	20	25
90-100k DWT Bulker	0	0	0	0	0	0	15
10-20k DWT Tanker	2	2	2	2	2	2	2
20-30k DWT Tanker	1	1	1	1	1	1	1
30-40k DWT Tanker	8	8	8	8	8	8	8
40-50k DWT Tanker	34	34	34	34	34	34	34
50-60k DWT Tanker	14	14	14	14	14	14	14
60-70k DWT Tanker	6	6	6	6	6	6	6
70-80k DWT Tanker	4	4	4	4	4	4	4
6-12k DWT Cruise	75	75	75	75	75	75	75
Total # Calls	**2648**	**2569**	**2544**	**2531**	**2523**	**2518**	**2509**

Table 3-11 shows the number of vessel calls estimated for 2030.

Table 3-11: # Calls Estimated for 2030

	2030						
Vessel Class Name	**40ft**	**42ft**	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
SPX1	152	152	152	152	152	152	152
SPX2	212	212	212	212	212	212	212
PX1	131	132	109	109	109	109	109
PX2	329	278	166	166	166	166	166
PPX1	511	283	209	206	205	205	205
PPX2	0	155	261	250	240	235	231
REEFER	19	19	19	19	19	19	19
RORO	306	306	306	306	306	306	306
VEHICLES CARRIER	803	803	803	803	803	803	803
GC	168	168	168	168	168	168	168
BARGE-GC-BULK	521	521	521	521	521	521	521
BARGE-TANK	35	35	35	35	35	35	35
10-20k DWT Bulker	1	1	1	1	1	1	1
20-30k DWT Bulker	3	3	3	2	2	2	2
30-40k DWT Bulker	9	9	9	6	6	6	5
40-50k DWT Bulker	24	24	24	14	14	14	11
50-60k DWT Bulker	15	14	14	17	17	17	14
60-70k DWT Bulker	43	41	38	13	13	13	12
70-80k DWT Bulker	36	33	31	33	33	30	9
80-90k DWT Bulker	0	0	0	24	24	22	26
90-100k DWT Bulker	0	0	0	0	0	0	16
10-20k DWT Tanker	3	3	3	3	3	3	3
20-30k DWT Tanker	1	1	1	1	1	1	1
30-40k DWT Tanker	9	9	9	9	9	9	9
40-50k DWT Tanker	38	38	38	38	38	38	38
50-60k DWT Tanker	15	15	15	15	15	15	15
60-70k DWT Tanker	7	7	7	7	7	7	7
70-80k DWT Tanker	4	4	4	4	4	4	4
6-12k DWT Cruise	75	75	75	75	75	75	75
Total # Calls	**3470**	**3341**	**3233**	**3209**	**3198**	**3188**	**3175**

Table 3-12 provides detail on the number of vessel calls estimated for 2040.

Table 3-12: # Calls Estimated for 2040

	2040						
Vessel Class Name	**40ft**	**42ft**	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
SPX1	197	197	197	197	197	197	197
SPX2	263	263	263	263	263	263	263
PX1	152	159	101	101	101	101	101
PX2	397	362	106	106	106	106	106
PPX1	707	384	224	222	220	220	220
PPX2	0	203	453	435	418	407	400
REEFER	23	23	23	23	23	23	23
RORO	367	367	367	367	367	367	367
VEHICLES CARRIER	1042	1042	1042	1042	1042	1042	1042
GC	220	220	220	220	220	220	220
BARGE-GC-BULK	576	576	576	576	576	576	576
BARGE-TANK	38	38	38	38	38	38	38
10-20k DWT Bulker	1	1	1	1	1	1	1
20-30k DWT Bulker	4	4	4	2	2	2	2
30-40k DWT Bulker	10	10	10	7	7	7	6
40-50k DWT Bulker	27	27	27	14	14	14	13
50-60k DWT Bulker	16	14	14	18	18	18	15
60-70k DWT Bulker	45	42	39	14	14	14	13
70-80k DWT Bulker	37	35	32	34	33	31	10
80-90k DWT Bulker	0	0	0	25	25	23	27
90-100k DWT Bulker	0	0	0	0	0	0	17
10-20k DWT Tanker	3	3	3	3	3	3	3
20-30k DWT Tanker	1	1	1	1	1	1	1
30-40k DWT Tanker	10	10	10	10	10	10	10
40-50k DWT Tanker	41	41	41	41	41	41	41
50-60k DWT Tanker	16	16	16	16	16	16	16
60-70k DWT Tanker	7	7	7	7	7	7	7
70-80k DWT Tanker	4	4	4	4	4	4	4
6-12k DWT Cruise	75	75	75	75	75	75	75
Total # Calls	**4279**	**4124**	**3894**	**3862**	**3842**	**3827**	**3814**

Table 3-13 provides detail on the number of vessel calls estimated for 2050.

Table 3-13: # Calls Estimated for 2050

	2050						
Vessel Class Name	**40ft**	**42ft**	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
SPX1	260	260	260	260	260	260	260
SPX2	334	334	334	334	334	334	334
PX1	202	211	135	135	135	135	135
PX2	531	483	144	144	144	144	144
PPX1	939	513	302	299	297	297	297
PPX2	0	270	599	575	552	537	528
REEFER	23	23	23	23	23	23	23
RORO	372	372	372	372	372	372	372
VEHICLES CARRIER	1042	1042	1042	1042	1042	1042	1042
GC	263	263	263	263	263	263	263
BARGE-GC-BULK	577	577	577	577	577	577	577
BARGE-TANK	38	38	38	38	38	38	38
10-20k DWT Bulker	1	1	1	1	1	1	1
20-30k DWT Bulker	4	4	4	2	2	2	2
30-40k DWT Bulker	10	10	10	7	7	7	6
40-50k DWT Bulker	27	27	27	14	14	14	13
50-60k DWT Bulker	16	14	14	18	18	18	15
60-70k DWT Bulker	45	42	39	14	14	14	13
70-80k DWT Bulker	37	35	32	34	33	31	10
80-90k DWT Bulker	0	0	0	25	25	23	27
90-100k DWT Bulker	0	0	0	0	0	0	17
10-20k DWT Tanker	3	3	3	3	3	3	3
20-30k DWT Tanker	1	1	1	1	1	1	1
30-40k DWT Tanker	10	10	10	10	10	10	10
40-50k DWT Tanker	41	41	41	41	41	41	41
50-60k DWT Tanker	16	16	16	16	16	16	16
60-70k DWT Tanker	7	7	7	7	7	7	7
70-80k DWT Tanker	4	4	4	4	4	4	4
6-12k DWT Cruise	75	75	75	75	75	75	75
Total # Calls	**4878**	**4676**	**4373**	**4334**	**4308**	**4289**	**4274**

3.3.2.4 *Sailing Draft Distribution & Load Factor Analysis*

Once the number of vessel calls has been determined a sailing draft distribution must be applied to determine the extent and frequency of channel usage. The distribution depicted in Figure 3-3 was based on Waterborne Commerce Statistics Center Entrances and Clearances data for container vessels. The data shown here represents a distribution of arrival drafts for every US Coastal Port between 2007 and 2010 compiled in an MS Access database.

Table 3-14: Sailing Draft Distribution

Sailing Draft	SPX	PX1	PX2	PPX1	PPX2
14	0.4%				
15	0.6%				
16	4.1%	0.0%			
17	1.2%	0.0%	0.0%		
18	4.5%	0.0%	0.0%		
19	2.1%	0.0%	0.0%		
20	7.4%	0.1%	0.0%		
21	6.5%	0.1%	0.1%		
22	5.2%	0.1%	0.1%		
23	7.0%	0.2%	0.1%	0.1%	
24	10.1%	0.8%	0.0%	0.0%	
25	7.8%	0.9%	0.1%	0.1%	
26	7.7%	2.1%	0.3%	0.1%	0.0%
27	7.1%	2.9%	0.4%	0.2%	0.0%
28	5.1%	5.1%	0.8%	0.4%	0.4%
29	3.0%	5.5%	1.2%	0.9%	0.6%
30	3.6%	9.2%	2.9%	1.4%	1.0%
31	5.9%	12.1%	8.0%	12.4%	18.6%
32	6.2%	11.0%	8.2%	5.4%	7.2%
33	1.9%	11.2%	8.1%	5.2%	4.2%
34	1.3%	9.4%	11.0%	11.1%	6.0%
35	0.7%	8.7%	11.0%	8.1%	4.9%
36	0.6%	8.7%	13.6%	9.5%	7.6%
37	0.2%	5.3%	12.5%	10.1%	6.7%
38	0.0%	4.1%	9.3%	8.0%	7.9%
39		1.5%	5.8%	8.3%	6.9%
40		0.6%	3.3%	7.5%	6.8%
41		0.4%	2.2%	6.1%	8.4%
42			0.9%	3.7%	6.8%
43			0.2%	0.8%	3.5%
44			0.2%	0.5%	2.1%
45				0.2%	0.3%
46				0.0%	0.1%
47					0.0%

Figure 3-3: Distribution of Arrival Drafts based on 2007 to 2010

The vessel movements in this data set were placed on trade routes based on the US Port of call, the vessel IMO#, month, date, and the trade country/region. The trade route was concatenated to the vessel class in the database allowing for summary statistics on the arrival drafts to be calculated for each route class. Table 3-15 provides detail on the arrival draft statistics for each route class[22]. The mean and the standard deviation were used to develop a normal distribution of arrival drafts to apply to each vessel call.

[22] The minimum arrival draft is calculated as the difference between the mean and the standard deviation.

Table 3-15: Sailing Draft Distribution Statistics by Trade Route and Vessel Class

Route-Class	Standard Deviation	Minimum	Mean	Maximum
FE-ECUS-PAN PX1	2.79	32.20	34.99	41.00
FE-ECUS-PAN PX2	3.09	32.13	35.22	44.00
FE-ECUS-PAN PPX1	3.76	31.38	35.14	45.00
FE-ECUS-PAN PPX2	4.34	31.73	36.07	47.00
FE-ECUS-SUEZ PX1	1.66	33.02	34.68	38.00
FE-ECUS-SUEZ PX2	3.67	32.10	35.77	44.00
FE-ECUS-SUEZ PPX1	3.43	32.73	36.16	45.00
FE-ECUS-SUEZ PPX2	2.80	37.00	39.80	46.00
FE-EU-ECUS-GMEX PX1	3.27	29.28	32.55	41.00
FE-EU-ECUS-GMEX PX2	3.28	32.21	35.49	43.00
FE-EU-ECUS-GMEX PPX1	3.61	33.26	36.87	46.00
FE-EU-ECUS-GMEX PPX2	2.80	34.20	37.00	46.00
ECSA-ECUS PX1	3.31	28.56	31.87	41.00
ECSA-ECUS PX2	2.81	33.93	36.74	41.00
ECSA-ECUS PPX1	3.66	32.55	36.21	41.00

A load factor analysis was done to determine the maximum vessel sailing draft and capacity by volume and/or deadweight by vessel class and trade route. The LFA estimates the overall volumetric and deadweight capacity after accounting for bunkerage, ballast, allowance for operations, empty TEUS, laden TEUS, tonnes of cargo/ laden TEU, and vacant slots. Table 3-16 provides detail on the inputs for the load factor analysis.

Table 3-16: LFA input Assumptions

Route	%Empty TEUS	%Vacant Slots
FE-ECUS-PAN	6.5%	7.7%
FE-EU-ECUS-GMEX	11.4%	7.7%
FE-ECUS-SUEZ	8.7%	4.7%
ECSA-ECUS	30.2%	6.2%

Table 3-17 provides detail on the maximum vessel capacity in metric tonnes and TEUS as a result of the load factor analysis.

Table 3-17: Determine the Maximum Draft and Capacity

Cargo	Class	MXSLLD	MXSLLD Capacity	MXSLLD TEU Capacity
FE-ECUS-PAN	PX1	35.3	30,719	3,123
FE-ECUS-PAN	PX2	37	35,839	3,643
FE-ECUS-PAN	PPX1	43.7	52,051	5,292
FE-ECUS-PAN	PPX2	45.4	73,384	7,460
FE-ECUS-SUEZ	SPX1	23.55	13,530	1,315
FE-ECUS-SUEZ	SPX2	27.69	21,647	2,104
FE-ECUS-SUEZ	PX2	38	37,883	3,683
FE-ECUS-SUEZ	PPX1	44.7	55,020	5,349
FE-ECUS-SUEZ	PPX2	47.4	77,570	7,541
FE-EU-ECUS-GMEX	SPX1	23.55	13,694	1,244
FE-EU-ECUS-GMEX	SPX2	27.69	21,910	1,990
FE-EU-ECUS-GMEX	PX1	37.3	32,865	2,985
FE-EU-ECUS-GMEX	PX2	39	38,343	3,482
FE-EU-ECUS-GMEX	PPX1	44.7	55,688	5,058
FE-EU-ECUS-GMEX	PPX2	47.4	78,511	7,131
ECSA-ECUS	SPX1	23.55	11,151	1,081
ECSA-ECUS	SPX2	27.69	17,842	1,729
ECSA-ECUS	PX1	33.3	26,764	2,594
ECSA-ECUS	PX2	35	31,224	3,026
ECSA-ECUS	PPX1	39.7	45,349	4,396

3.3.3 HARBORSYM SETUP

Docks

Reaches

Commodity Info

3.3.4 SUMMARY OF METHODS & ASSUMPTIONS

The estimation of transportation cost savings conducted in this analysis is based on the following assumptions:

- **Container Cargo**
  - Vessels with a deeper sailing draft are assumed to have more cargo.
  - The commodity forecast is the same for the future without and future with project conditions.
  - It was assumed that in the future without project condition, the largest container vessel deployed to Jacksonville would be PPX1.

    - The largest container vessels moving through the port are PPX1 for the East West trades in the future without project condition.
    - For the North-South trade, there is no difference in the future with and without project condition fleet composition.
    - Post Panamax vessels on the FE-ECUS-PAN route were given the same sailing draft distribution as those on the FE-WCUS trade.
    - The load factor analysis used the same proportions of vacant slots and empties as the Savannah Harbor economic analysis.
    - Container Weight = 2 metric tonnes / TEU
    - Most of the information in this analysis is specific to containers.
- **Dry Bulk Cargo**
    - No sailing draft distribution was applied to the bulker calls in either the future with or the future without project condition.

4 The Future Possibilities: FWOP – 50ft

4.1 Transportation Cost By Channel Depth

The purpose of this section is to describe the transportation costs estimated for the future without project condition and cost savings for the alternatives. The parameters under which these transportation costs were estimated are as follows:

- Parameters
  - Discount Rate – 3.75%
  - Base Year – 2020
  - Year to end growth - 2050
  - # life cycles – 100

Transportation costs in AAEQ dollars range between $648.6and $654.8 million AAEQ. Figure 4-1 illustrates the distribution of transportation cost based on the HarborSym run outputs. The mean and median of the distribution are in the $652 M range, while the standard deviation is just over $1M. Most of the distribution (96%) is located between $651M and $654M. The distribution is characterized by a slightly positive skew and kurtosis. The implication is that while the 40' transportation cost exhibit minimal variability given the relatively small standard deviation and positive kurtosis.

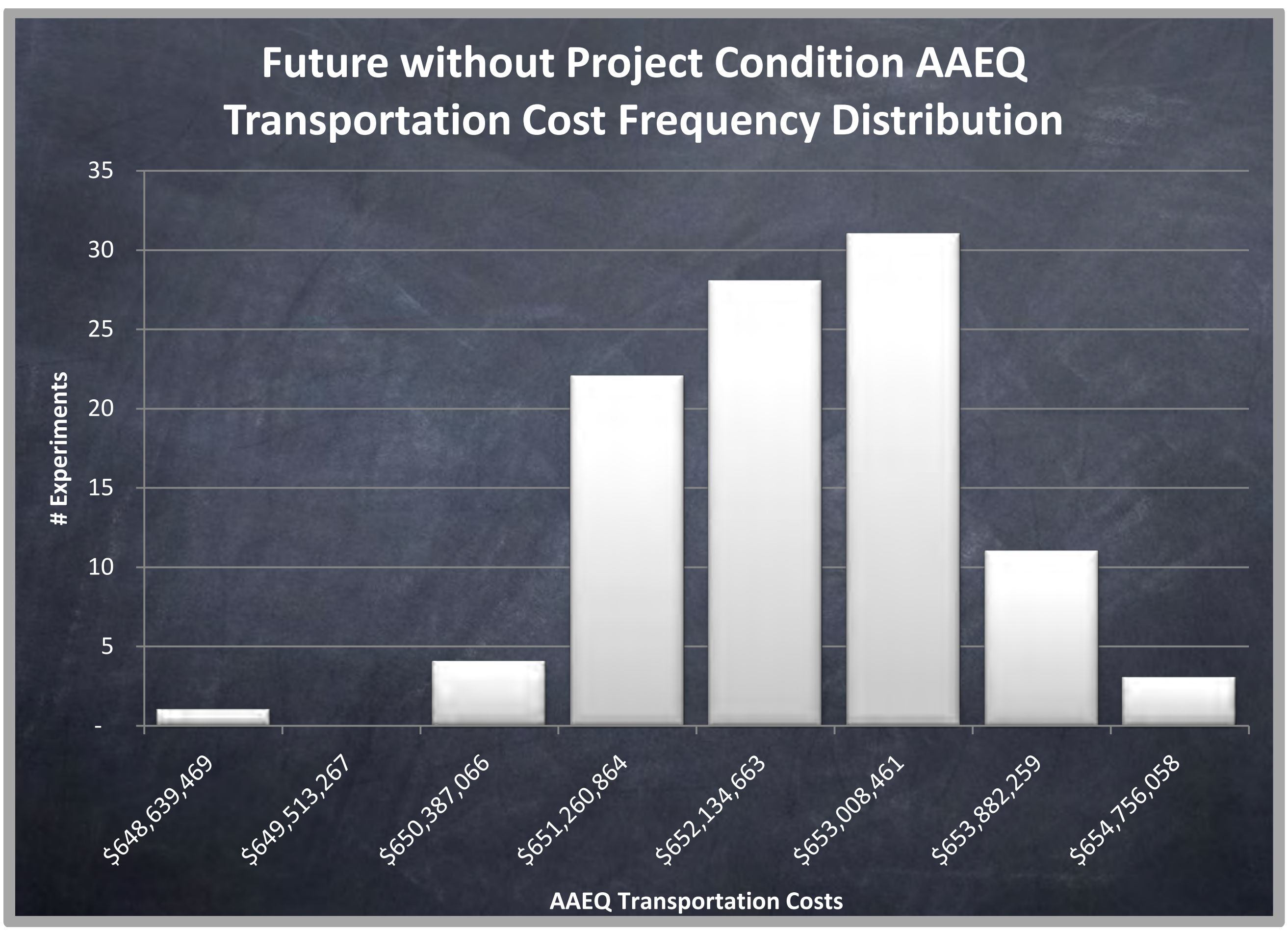

Figure 4-1: Future without project condition transportation cost distribution

Table 4-1 displays the descriptive statistics on the results of the HarborSym model runs using the same parameters as those described for the 40ft future without project condition. **Error! Reference source not found.** illustrates the relationship between channel depth and transportation cost.

Table 4-1: Transportation Cost By Channel Depth

Statistic	40ft	44ft	45ft	46ft	47ft	50ft
Mean	$651,905,189	$606,311,090	$601,788,069	$600,982,954	$599,768,469	$595,510,485
SD	$1,019,657	$1,078,042	$1,196,026	$1,147,818	$1,155,581	$1,230,883
Median	$651,870,358	$606,349,936	$601,678,460	$600,909,099	$599,781,500	$595,546,198
Min	$648,639,469	$603,802,741	$598,902,102	$598,590,255	$597,010,244	$592,656,793
Max	$654,756,058	$608,971,032	$604,323,189	$604,575,172	$602,816,392	$598,180,602
Range	$6,116,589	$5,168,290	$5,421,087	$5,984,917	$5,806,148	$5,523,809
Skewness	0.01	0.04	0.01	0.42	(0.05)	(0.16)
Kurtosis	0.49	(0.43)	(0.52)	0.45	(0.21)	(0.38)
Confidence	$199,849	$211,292	$234,417	$224,968	$226,490	$241,249

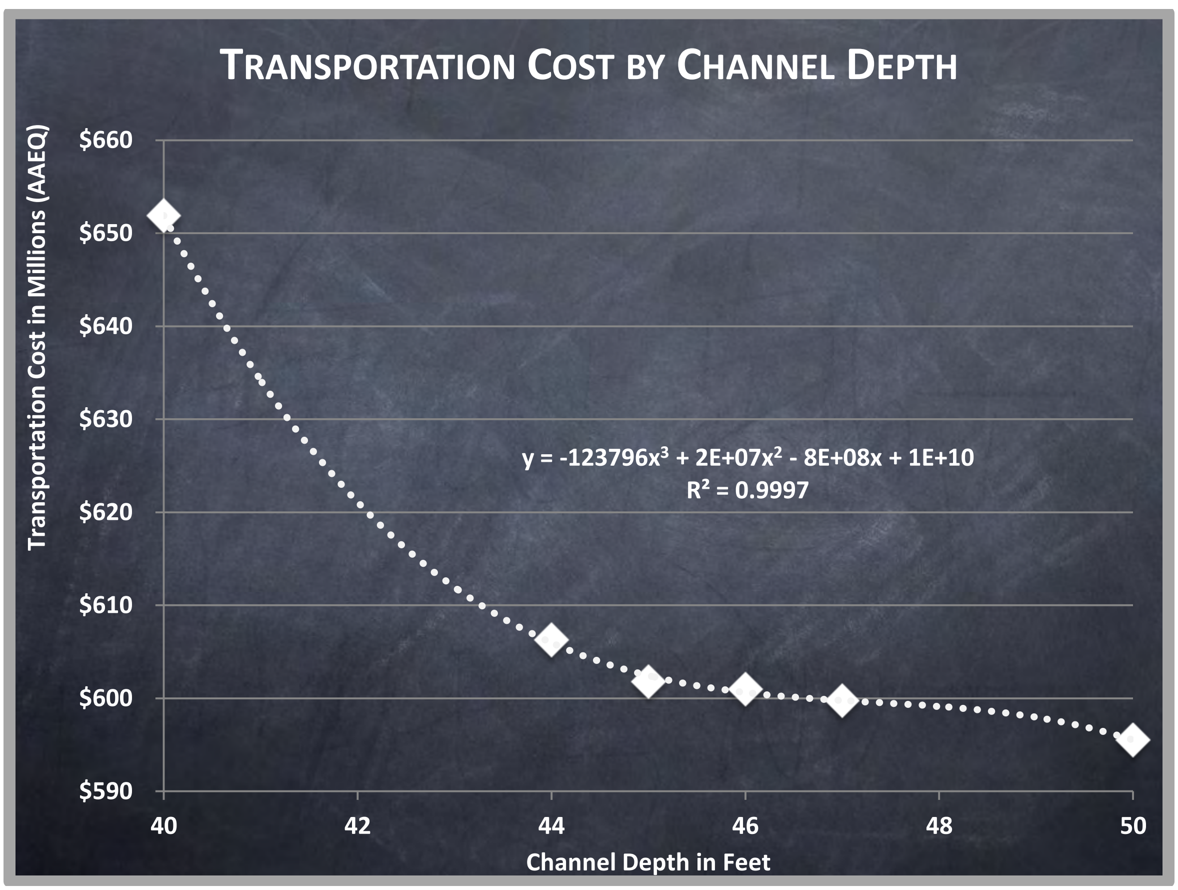

Figure 4-2: Transportation Cost by Channel Depth

Analysis of the transportation cost of the various deepening alternatives reveals the following:

- The variability in the results seems to increase with the channel depth between 40 and 45 ft, and again between 46 and 50 ft. This likely reflects the interplay between the number of vessel calls between each depth and the overall changes in the sailing draft distribution possibilities. As the channel gets deeper, there is a larger range of potential sailing drafts.
- **Error! Reference source not found.** which shows the relationship between channel depth and transportation cost, shows a precipitous decline in transportation cost up to 44'. This reflects the rate of fleet transition to PPX2 vessels. The 1st transition occurs at 42' and the maximum transition is at 44'. Also, there is a significant transition of bulkers to 80-90k DWT Bulkers at 45' and another transition at 50' to between 90-100k DWT Bulkers.

4.2 ECONOMIC BENEFITS BY ALTERNATIVE

This section displays the transportation cost savings per channel depth alternative as well as the net benefits and BCR for the analysis. **Error! Reference source not found.** illustrates the economic benefits by channel depth. **Error! Reference source not found.** display the % frequency distribution of the net benefits.

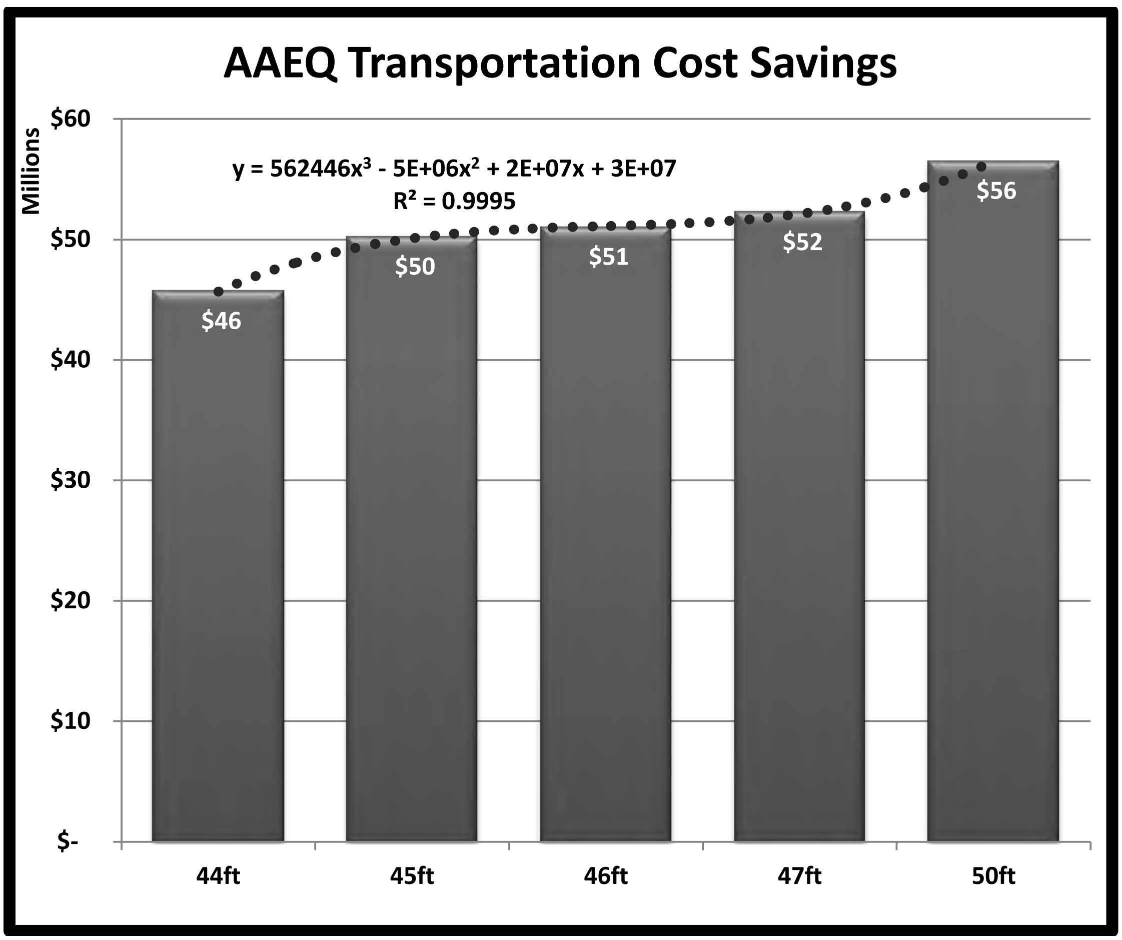

Figure 4-3: AAEQ Transportation Cost Savings by Channel Depth

Table 4-2 provides detail on the percentage distribution of benefits by cargo for the simulations ran for 2020 and 2030. Table 4-3 provides the same information 2040 and 2050. The East-West trades represent the majority of the benefits for each depth alternative. As the channel depth increases the dry-bulk benefits represent an increasing share. The FE-ECUS-PAN and FE-EU-ECUS-GMEX trade routes represent a greater share of the economic benefits of deepening due to heavier trade weights and deeper sailing draft distribution. 98% of the benefits are from the cargoes that benefit from the deepening.

Table 4-2: Benefits by Cargo Type in Constant Dollars

	2020				
Cargo	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
FE-ECUS-PAN	19.1%	16.8%	16.5%	15.0%	13.6%
FE-ECUS-SUEZ	27.4%	25.3%	24.5%	23.8%	21.2%
FE-EU-ECUS-GMEX	24.6%	20.4%	21.6%	20.8%	17.0%
COAL	16.8%	25.7%	25.7%	27.5%	28.8%
DRY-BULK	9.7%	8.9%	10.1%	9.7%	16.8%
ECSA-ECUS	0.2%	1.2%	1.5%	1.9%	0.6%
GENERAL-CARGO	0.4%	0.2%	0.5%	0.2%	0.3%
CAR-PR-JAX	0.1%	-0.2%	-0.2%	-0.1%	0.2%
LIQUID-BULK	0.0%	0.2%	0.4%	0.0%	0.1%
PASSENGERS	1.8%	1.5%	-0.5%	1.0%	1.5%
	2030				
Cargo	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
FE-ECUS-PAN	20.3%	19.2%	19.1%	19.6%	18.2%
FE-ECUS-SUEZ	40.4%	36.0%	35.8%	34.9%	32.6%
FE-EU-ECUS-GMEX	30.5%	28.0%	27.0%	25.8%	25.3%
COAL	7.6%	11.6%	12.3%	13.3%	15.6%
DRY-BULK	0.3%	3.0%	3.7%	4.6%	5.9%
ECSA-ECUS	1.7%	1.6%	2.0%	1.3%	2.0%
GENERAL-CARGO	-1.0%	-0.2%	-0.1%	-0.3%	-0.5%
CAR-PR-JAX	0.0%	0.1%	0.1%	0.0%	0.1%
LIQUID-BULK	0.4%	0.3%	0.2%	0.4%	0.3%
PASSENGERS	-0.4%	0.5%	-0.2%	0.5%	0.5%

The marginal benefits tend to be the highest at depths where the fleet transitions

Table 4-3: Benefits by Cargo in Constant Dollars

	2040				
Cargo	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
FE-ECUS-PAN	20.7%	20.7%	20.0%	20.0%	20.0%
FE-ECUS-SUEZ	42.8%	40.6%	41.7%	41.8%	38.1%
FE-EU-ECUS-GMEX	28.1%	25.9%	26.3%	26.2%	24.2%
COAL	4.9%	7.7%	8.1%	8.3%	10.6%
DRY-BULK	2.2%	3.5%	3.3%	3.4%	5.3%
ECSA-ECUS	1.3%	1.4%	0.9%	0.9%	0.9%
GENERAL-CARGO	0.0%	-0.3%	-0.6%	-0.7%	0.4%
CAR-PR-JAX	0.0%	-0.1%	0.1%	0.1%	0.0%
LIQUID-BULK	-0.2%	0.0%	-0.1%	-0.1%	-0.1%
PASSENGERS	0.3%	0.7%	0.2%	0.2%	0.6%
	2050				
Cargo	**44ft**	**45ft**	**46ft**	**47ft**	**50ft**
FE-ECUS-PAN	18.3%	18.0%	18.5%	19.4%	17.2%
FE-ECUS-SUEZ	46.6%	45.2%	44.3%	43.4%	42.7%
FE-EU-ECUS-GMEX	26.3%	25.3%	25.4%	24.4%	24.2%
COAL	3.6%	5.9%	6.1%	6.6%	8.4%
DRY-BULK	1.8%	2.8%	2.7%	3.7%	4.6%
ECSA-ECUS	3.1%	2.5%	2.8%	2.2%	2.1%
GENERAL-CARGO	0.2%	0.5%	0.3%	0.4%	0.7%
CAR-PR-JAX	0.2%	0.1%	0.0%	0.0%	0.1%
LIQUID-BULK	0.1%	0.0%	0.0%	0.0%	-0.1%
PASSENGERS	-0.1%	-0.2%	-0.1%	0.0%	0.0%

Bin	44ft	45ft	46ft	47ft
$ 11,152,073				1%
$ 12,897,519			3%	6%
$ 14,642,964			18%	33%
$ 16,388,410	1%		35%	34%
$ 18,133,856	5%		33%	21%
$ 19,879,301	27%	3%	11%	5%
$ 21,624,747	42%	23%		
$ 23,370,192	23%	32%		
$ 25,115,638	2%	36%		
$ 26,861,083		6%		

Figure 4-4: Distribution of Net AAEQ Benefits

The economic summary is presented as a range of values below.

- **44’**
  - AAEQ Benefits ....$40.0M – $49.0M
  - Net AAEQ Benefits ....$14.9M – $23.9M
  - BCR ....1.60 – 1.95

- **45’**
  - AAEQ Benefits ....$46.2M – $54.3M
  - Net AAEQ Benefits ....$18.8M – $26.9M
  - BCR ....1.68 – 1.98

- **46’**
  - AAEQ Benefits ....$46.9M – $54.0M
  - Net AAEQ Benefits ....$11.9M – $19.0M
  - BCR ....1.34 – 1.54

- **47’**
  - AAEQ Benefits ....$48.2M – $55.8M
  - Net AAEQ Benefits ....$11.1M – $18.7M
  - BCR ....1.30 – 1.51